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DEFENSE INDUSTRY BULLETIN

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IN THIS ISSUE

FEATURES

U.S. Army Test and Evaluation Command—Reliable Equipment for Arctic, Jungle, Desert
Benjamin S. Goodwin ---------- 1

Evolution of DSA Procurement Quality Assurance
George G. Gula ---------- 6

ICAF Correspondence Study—Keeping Pace with Change
Lieutenant General John S. Hardy, USAF ---------- 19

ASPR Committee Case Listing ---------- 24

Air Force Flight Dynamics Laboratory
Colonel Joseph R. Myers, USAF ---------- 26

DEPARTMENTS

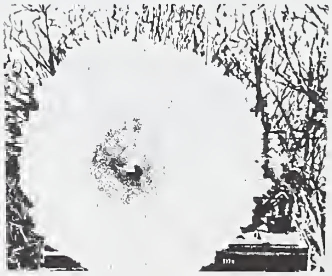
From the Speakers Rostrum ---------- 11

Bibliography ---------- 18

About People ---------- 29

Meetings and Symposia ---------- 31

Defense Procurement ---------- 32



Resembling a gigantic blossom, the Shillelagh missile is caught at the moment of firing from its Sheridan launch vehicle in the photo on the cover. Testing and evaluating new armored vehicles is just one facet of the mission of the Army Test and Evaluation Command, whose story is featured in this issue.

U.S. Army Test and Evaluation Command

Reliable Equipment for Arctic, Jungle, Desert

Benjamin S. Goodwin

Of all the soldierly skills, probably the least static today is the age-old art of logistics.

If it is to succeed at all, the essential military business of "moving, supplying and quartering troops" must be conducted in an atmosphere of bold enterprise. It tolerates no plateau of achievement but demands continuous exploitation of each successful assault on the frontiers of knowledge. The alternative—tacit acceptance of the *status quo*—offers only dismal prospects for American arms.

In an age which is, literally, reaching for the stars, the military necessity for keeping up with the headlong pace of modern technology, management and industrial development is clearly demonstrable. It is reflected in the 1962 reorganization of the Army.

Among other things, the reorganization called for a major overhaul of the existing logistics and materiel structure, plus a realignment of basic responsibilities along functional lines. It also demanded more effective management of research, development and logistics resources and, especially, the accelerated delivery of new weaponry and equipment.

Since 1962, the three major Army field commands have shared in a forward-looking system for the development, procurement and support of Army materiel and equipment. Their individual tasks are unique but so closely related that it is sometimes hard to tell where the responsibilities of one leave off and those of the others begin.

- The Combat Developments Command (CDC), for instance, is charged with establishing requirements. It provides the detailed blueprints which determine how the Army will fight, how it will be organized, and how it will be equipped in all future time frames and environments.
- The Continental Army Command (CONARC) is responsible for the timely delivery of trained fighting units, organized and equipped to meet the requirements spelled out by CDC.
- At the same time, the Army Materiel Command (AMC) is expected to develop, produce, supply and maintain the panoply of weapons, equipment and other gear that will be required by the combat forces. With a few exceptions, management of wholesale materiel activities is largely the province of AMC, currently and aptly described as the *Arsenal for the Brave.*

From the beginning, AMC has not hesitated to apply brave new concepts to its massive logistics mission. Not the least of these were sweeping changes in the materiel development process itself and the establishment of an independent materiel testing organization—the U.S. Army Test and Evaluation Command (TECOM) at Aberdeen Proving Ground, Md.

The materiel development process is, largely, an in-house-initiated undertaking. While some items on the Army shopping list can be obtained directly from commercial sources, *e.g.* non-tactical automotive vehicles and aircraft, most of them are the end-product of deliberate research, development, test and evaluation programs initiated by the Army team.

Where the development process starts depends, in a sense, on the nicety of an individual's semantics and his appreciation of technical verbiage. The evolutionary path of most Army hardware, however, is marked plainly and, by and large, the formal metes and bounds are easy to identify.

From concept to disposal, the typical life cycle of Army materiel covers a span of about 30 years, by definition, a full human generation. Six distinct phases are evident in this pattern. Concept and definition stages, varying widely in duration and depth, are succeeded, normally, by a 4-year development cycle, an 8-year production phase, and a 10-year service life. Understandably, all projects do not conform to these ideals: the M1911 automatic pistol, for example, still tops the list of standard side arms.

The development phase, with which TECOM is concerned, generally opens with the establishment of requirements and ends with type classification actions to categorize an item or system according to its suitability for service use. Requirements documents, produced by CDC, include qualitative materiel development objectives (QMDOs), qualitative materiel requirements (QMRs), and small development requirements (SDRs).

The QMR is a statement, approved by the Department of the Army, of a military need for a specific item, system, or assemblage, the development of which is believed feasible. A QMR describes the desired capabilities of the proposed item, its technical and military characteristics, and the operational and organizational environment in which it is to be used. Similarly, SDRs are issued to cover items that can be developed at relatively low cost in short periods of time. The QMDO usually precedes the QMR in point of time, and is associated with proposed requirements in which it appears that further research and study are necessary to determine feasibility.

With an approved QMR or SDR in hand, AMC is ready to begin the task of translating requirements into hardware or, more likely, into technical information and data suitable for use on the production line.

TECOM
Mission and Organization

The Test and Evaluation Command, a subordinate element of AMC and a burgeoning newcomer to Army logistics, serves as the Army's principal materiel testing organization. It provides the Army with independent, unbiased appraisals of its materiel. It also provides testing support beyond the in-house capabilities of developing and producing commands and contractors. From its test report, TECOM's only product, the Army can determine if an item conforms to specifications, if it is capable of doing the things it was built to do, and if it is, in fact, suitable for field use.

The physical plant maintained by TECOM includes the facilities of 15 proving grounds, service test boards, environmental test centers and a general equipment test activity. Some of the Army's largest reservations are among the command's test sites in the continental United States, Alaska and Panama.

With a military and civilian work force of about 20,000, TECOM is prepared to test Army materiel of almost every description under closely controlled laboratory conditions, in the field, and in the most extreme natural environments. While the bulk of its work is conducted in temperate regions, test operations go on continuously in the arid western deserts, in the humid jungles and rain forests of the tropics, in howling arctic blizzards.

Management of this far-flung test complex by TECOM is accomplished by a modest size headquarters group, located at Aberdeen Proving Ground, Md. The headquarters is a conventional directorate-type organization with special provisions for accomplishing its complicated test and evaluation mission. Some of its unusual features include:

- A coordinating staff, consisting of eight commodity-oriented materiel testing directorates, under the deputy chief of staff.
- A Plans and Operations Directorate responsible for regulating test and evaluation activities of the command; scheduling test projects; controlling installation workloads; supervising the command-wide instrumentation program and instrumentation research and development; review and analysis of test reports; and exercising staff responsibility for test policy, procedures and regulations.
- A highly sophisticated Management Science and Data Systems Office concerned with developing management techniques and information systems.
- Systems test managers responsible for directing major test programs which require special command attention.

Testing Philosophy

Operations of the command today are geared to a mature testing philosophy which, of necessity, leans heavily on standardization and centralized authority. With about 4,000 heterogeneous tests or testing tasks continuously on the books, keeping track of day-to-day activities is a formidable task. Computer applications provide the basic data for making intelligent management decisions quickly and accurately. The establishment of uniform procedures has paid the highest dividends in terms of management and control—and has contributed immeasurably to a commonality of understanding between developer, producer and tester alike.

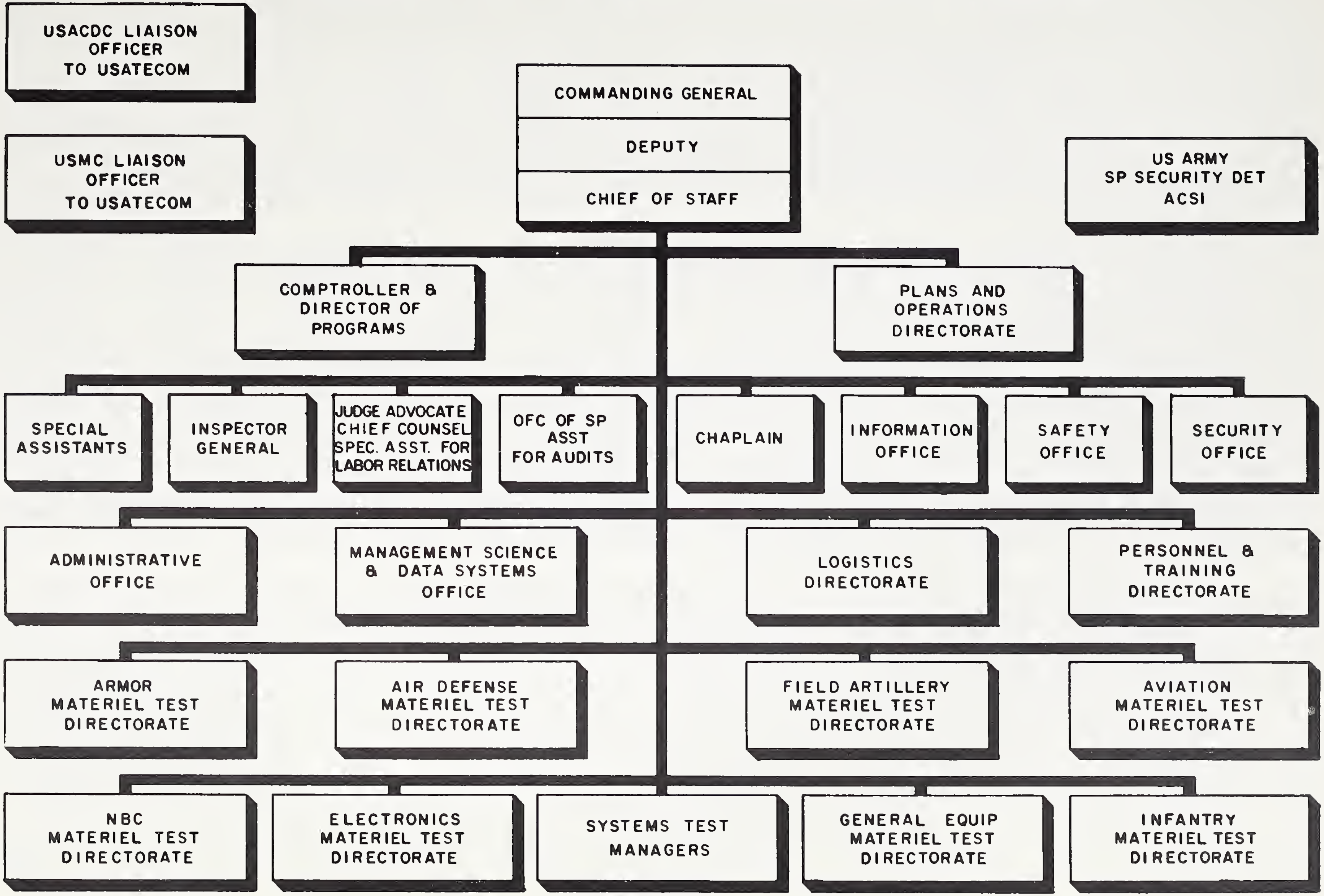
The Army's repertoire of official tests—currently, about a score in number—is associated with all phases in the life cycle of Army materiel. Within TECOM they fall into two broad categories.

In one group are the engineering and service tests performed as part of its basic mission. In these instances, test plans, test reports and other details are the primary responsibility of TECOM. Test results, produced by independent test and evaluation, are furnished to AMC for use in making decisions respecting type classification. Included in this category are initial production tests which are, essentially, re-tests run to determine that deficiencies detected during service testing have been corrected, that modifications resulting in the change from research and development to production are acceptable, and to provide a

Benjamin S. Goodwin has been Special Assistant and Technical Advisor to the Commander, Army Test and Evaluation Command, since 1962. Prior to assuming this position, he served for 12 years as an engineer with Aberdeen Proving Ground's Development and Proof Services. Mr. Goodwin holds a B.S. degree in mechanical engineering from Georgia Institute of Technology.

PROVISIONAL

HEADQUARTERS
U.S. ARMY TEST & EVALUATION COMMAND


USACDC LIAISON OFFICER TO USATECOM
USMC LIAISON OFFICER TO USATECOM
COMMANDING GENERAL
DEPUTY
CHIEF OF STAFF
US ARMY SP SECURITY DET ACSI
COMPTROLLER & DIRECTOR OF PROGRAMS
PLANS AND OPERATIONS DIRECTORATE
SPECIAL ASSISTANTS
INSPECTOR GENERAL
JUDGE ADVOCATE CHIEF COUNSEL SPEC. ASST. FOR LABOR RELATIONS
OFC OF SP ASST FOR AUDITS
CHAPLAIN
INFORMATION OFFICE
SAFETY OFFICE
SECURITY OFFICE
ADMINISTRATIVE OFFICE
MANAGEMENT SCIENCE & DATA SYSTEMS OFFICE
LOGISTICS DIRECTORATE
PERSONNEL & TRAINING DIRECTORATE
ARMOR MATERIEL TEST DIRECTORATE
AIR DEFENSE MATERIEL TEST DIRECTORATE
FIELD ARTILLERY MATERIEL TEST DIRECTORATE
AVIATION MATERIEL TEST DIRECTORATE
NBC MATERIEL TEST DIRECTORATE
ELECTRONICS MATERIEL TEST DIRECTORATE
SYSTEMS TEST MANAGERS
GENERAL EQUIP MATERIEL TEST DIRECTORATE
INFANTRY MATERIEL TEST DIRECTORATE

basis for determining the suitability of test items for final type classification.

In the second group of tests staged by TECOM are those performed as a service for commodity commands, project managers, Army contractors and manufacturers, the other Services, and other authorized agencies. Examples are feasibility, engineer design, and military potential tests connected with research and development, initial production and confirmatory type tests conducted during the production phase, and product improvement and surveillance tests in the operational phase. Under these circumstances, the "customer" prescribes test plans and objectives, establishes procedures for processing and distributing reports, and foots the bill. More than half of the TECOM workload is concerned with this type of testing.

Early Planning and Programming

Test planning and programming is started as early as possible in the development process to ensure maximum efficient use of all available information. The first step taken is the preparation of a Coordinated Test Program (CTP). This plan is a responsibility of the developer with input from TECOM.

Basically, the CTP functions as a schedule for development and testing purposes. It specifies whether an integrated, concurrent, or sequential test program will be followed, and establishes test objectives and outlines test schedules. It also establishes the number of prototypes required, the environmental testing deemed necessary, plus the funds and test support that will be required.

CTP annexes provide additional guidance to assist test planners. All background on the project is included in the CTP, together with a comprehensive description of the materiel and available photographs and drawings. Special support requirements outline anticipated need for unusual test facilities, instrumentation, specialized test equipment, manpower, transport, and contractor assistance. Not uncommonly, such requirements touch off significant construction and training programs, as well as extensive research and development in the fields of instrumentation and methodology.

TECOM installations and activities usually commence planning when test directives are issued by the headquarters. These directives are the signal for preparation of test plans by each TECOM agency concerned. When approved by the cognizant materiel test directorate of TECOM headquarters (for service tests by the Combat Developments Command), the test plan provides detailed guidance for conducting the prescribed test.

Engineering tests are conducted at four proving grounds; by the General Equipment Test Activity at Fort Lee, Va.; and by White Sands Missile Range, the national range operated by TECOM near Las Cruces, N.M.

The objective of the engineering test is to determine the technical performance and safety characteristics of an item or system and its associated tools and test equipment, as decribed in the pertinent QMR. It is characterized by controlled conditions and the elimination of human errors in judgment, so far as possible. Engineering tests are performed through the use of environmental chambers, physical measurement techniques, statistical methodology, personnel trained in engineering and scientific fields, and controlled laboratory, shop and field trials. Data is provided by these tests for use in development and for determinations regarding the technical and maintenance suitability of materiel for service test.

Items slated for engineering tests usually are assigned to TECOM test activities at:

- **Aberdeen Proving Ground**—Artillery, ammunition, infantry and aircraft weapons, wheeled and tracked vehicles, armor, and electronic control and guidance systems.
- **White Sands Missile Range**—Missiles, rockets, and similar devices.
- **Electronic Proving Ground**—Electronic equipment and systems, communications items, surveillance instruments, and devices to disrupt enemy communications.
- **Deseret Test Center**—Chemical, biological and radiological munitions; and agents and defense systems for evaluation at Dugway Proving Ground.
- **Jefferson Proving Ground**—Ammunition, fuzes, and mines.
- **General Equipment Test Activity**—Quartermaster and general purpose equipment not within the purview of other test activities.
- **Yuma Proving Ground**—Aerial delivery equipment.

Service tests, the primary responsibility of TECOM's service test boards, result in what are, essentially, user reports. They are aimed at determining to what degree the test item and its maintenance package meet the requirements of the QMR.

Using soldiers representative of those expected to operate and maintain the equipment in the field, the service test is and has been conducted with a minimum of instrumentation under simulated or actual field conditions. It is characterized by qualitative observations and judgments of military personnel who have a background of experience with the type of materiel under test.

Service test boards are assigned missions for testing materiel in the following categories:

- **Airborne, Electronics and Special Warfare Board**—Airborne equipment, including aircraft, designed to facilitate air drop or air transport of troops, supplies and equipment; communications equipment, employed at the division level or below; combat surveillance and special warfare equipment.
- **Air Defense Board**—Air defense weapons, air defense electronics equipment and devices, target devices, atomic demolition munitions.
- **Armor and Engineer Board**—Armor and engineer items, automotive systems and materiel, excluding certain engineer, quartermaster and transportation items.
- **Aviation Test Board**—Aircraft items, systems and related equipment.
- **Infantry Board**—Weapons and other items used by infantry units for target acquisition, ground surveillance, fire control and ground mobility; field-type clothing, equipment and rations for small units and individuals; anti-personnel mines; chemical and biological warfare equipment for small units and individuals; clothing and equipment for parachutists.
- **Field Artillery Board**—Field artillery, guided missiles and related materiel.

Since most military equipment today is designed for world-wide use, the total test package usually includes provisions for subjecting materiel to the extreme natural environments in which they are expected to operate. Three environmental test centers are maintained by TECOM to meet these purposes.

Desert environmental tests are conducted at Yuma Proving Ground in Arizona. Here, approximately a million acres of arid wasteland are available for wringing out Army equipment in the dry, dusty terrain of the American Southwest. About 40 percent of the area is hilly or mountainous; the remainder is generally flat desert pavement, sand plains, washes and bottomland, all deadly adversaries of man and his machines. The proving ground mission includes tests of air delivery equipment and air delivery tests.

In sharp contrast are TECOM's operations in the humid tropical environment of Panama where the Tropic Test Center is headquartered at Fort Clayton in the Canal Zone. Combined with dense tropical undergrowth, the mud, heat and humidity of the jungle test sites offer a continuing challenge to the soldier and the equipment he must operate and maintain under these conditions.

TECOM's cold-weather test missions are assigned to the Arctic Test Center at Fort Greely, Alaska. Located less than 180 miles below the Arctic Circle, the center "enjoys" some of the worst conditions the long, cold Alaskan winters can offer. The extreme cold of the test season, combined with the chilling winds and drifting snows, makes for an ideal test climate. As with most materiel tested in environmental extremes, much emphasis is placed on determining the compatability of the soldier and his equipment, as well as surfacing shortcomings and deficiencies in the materiel itself.

While mobility is an intangible quality of Army materiel, it is a subject of keen interest to the General Equipment Test Activity (GETA). In addition to its basic responsibility for testing general use items, rail and marine equipment and non-tactical and commercial vehicles, the command routinely reports on the suitability of materiel for use in logistics-over-the-shore (LOTS) operations, its adaptability for movement and delivery by all modes of transportation (MOVAD), and its cargo loading adaptability.

LOTS operations are concerned with the loading and unloading of ships over unimproved shore lines and through partially destroyed port facilities. To be considered for use in operations of this type, vehicles must be able to move from landing craft and other vessels to the beach and then proceed to points at least two miles inland.

Amphibious vehicles are expected to reach the inland areas under their own power from points five miles off shore. Those classed as "non-swimmers" need only be capable of negotiating a fordable surf after being debarked from beached landing craft.

MOVAD trials are conducted by GETA to determine the transportability of materiel in service-ready condition by rail, water, highway and air. Standard tests include observing and inspecting items and components under actual movement conditions. During these evaluations, consideration is given to such things as the adequacy of lifting devices, tie-down provisions, hazardous and unusual characteristics, ground clearances and angles of break, approach and departure in relation to movements into, on and off various means of transport.

Cargo loading adaptability trials are conducted to determine the classes and mixtures of military cargo that can be loaded on or unloaded from the test item. Limitations of materials handling equipment and similar difficulties are noted during these investigations.

In practice, appropriate classes and mixtures of military cargoes make up the test loads. Available materials handling equipment of types organic to port, depot and terminal organizations, as well as research and development prototypes, are used for loading and unloading. Various loading patterns are accomplished from shipside, ground level, warehouse docks, rail cars and other vehicles.

GETA also performs certain line haul evaluations to determine the suitability of test items for use as troop and logistical carriers in theaters of operations.

In these evaluations, test and comparison vehicles cover a minimum of 1,000 miles, 50 percent by highway, 30 percent by secondary roads, and 20 percent over cross-country terrain. Half the mileage is logged with vehicles loaded to rated capacity; the other half is traversed with unloaded vehicles.

Records of operating costs are maintained throughout line haul evaluations. These include total mileage and data on fuel, oil, grease and repair parts, plus maintenance requirements. Fuel consumption in payload ton-miles per gallon and cost per ton-mile of operation is closely observed.

Test Evaluation Documentation

As might be surmised, documentation of the test function is on the elaborate side—and rightly so.

Test plans prepared by TECOM test activities, for instance, prescribe in considerable detail the functional and environmental techniques and procedures to be followed. They are shaped to meet the standards and objectives stated in applicable portions of the TECOM Materiel Test Procedures, test directives, QMRs, SDRs, and technical characteristics data.

The documentary products of testing consist of less than a dozen standard test reports serving a variety of purposes. Of these, the Equipment Performance Report and the Final Test Report are typical.

- **Equipment Performance Reports** are issued by test agencies as a rapid means of informing commodity commands, project managers and others concerned when specific failures, malfunctions, or deficiencies crop up in equipment being tested. The reports identify failed components, briefly describe the conditions under which they failed and, sometimes, suggest redesign action.
- **Final Test Report** is the formal report rendered by testing agencies upon completion of testing. It contains the conclusions and recommendations of the test activity and describes in detail the test purposes, procedures followed, and results obtained. TECOM recommendations regarding the suitability of materiel for Army use, further development, or other action are based on this report. Generally speaking, AMC decisions on type classification are also shaped by the Final Test Report.

Testing, of course, is not an end in itself. Neither is it a dispensable step in the logistics system as we know it today. Too much is at stake.

By any standard of comparison, the AMC logistics mission, in which TECOM now plays a critical role, is a task of herculean proportions. From its arsenals, depots, shops, procurement centers and other supply sources, AMC supplies the combat forces with a measured mix of basic necessities—food, clothing, shelter—as well as the munitions of war. In addition, it must provide *now* for the needs of tomorrow's soldier by devel-

(Continued on Page 23)

Evolution of DSA Procurement Quality Assurance

George G. Gula

The rapid advance of technological progress from the decade of 1950 through 1960, particularly in the missile, aerospace and nuclear propulsion programs, has also advanced Defense Supply Agency (DSA) quality assurance concepts from "go" "no go" inspection to a system concept of quality assurance. Recognizing the sophistication of weaponry, DSA requires contractors to design and maintain a quality control program to assure compliance with requirements of the contract.

The Procurement Quality Assurance Program (PQAP) is administered by the Defense Contract Administration Services (DCAS) Quality Assurance Directorate of the Defense Supply Agency.

Procurement Quailty Assurance Program

In this present state of metamorphosis, the system concept is a program of interrelated elements performed by quality assurance personnel to assure that contractual requirements have, in fact, been complied with by the contractor prior to acceptance of the product. A contractor's quality program, to be effective, must be documented and must include control of all work operations and manufacturing processes, as well as inspections and tests. It should be emphasized that the interrelated elements of the DCAS Procurement Quality Assurance Program provides indicators or sensors of the contractor's quality control program and the product's conformance to specification requirements. Successful results in the form of good product quality can be assured by effective and systematic implementation of five elements of PQAP:

- **Procedures Review.** Written procedures are generated by the contractor to document quality or inspection method. A review is made of these procedures for conformance and to assure that they adequately specify manufacturing techniques, controls, and inspections. The review is conducted prior to start of production. In addition, during the review, a checklist is developed to use during production for continuing evaluation of procedures in operation.
- **Procedures Evaluation.** Satisfactory procedures review leads directly to procedures evaluation as contractor production progresses. Procedures evaluation, in essence, assures that the contractor follows his written procedures. Prove-out is accomplished as early as possible throughout the entire manufacturing cycle to verify the completeness and adequacy of the contractor's procedures in operation. An incidental benefit is assurance that contractor adherence to the procedures results in delivery of quality products, manufactured to contract requirements. Checklists, developed during procedures review, are used in subsequent evaluations to ensure maintenance of satisfactory quality and process controls; thus, assurance is provided that the contractor's manufacturing processes and inspections remain in accordance with written procedures, thereby maintaining quality control.
- **Product Inspection and Test.** Direct inspection of product characteristics, in-process and end item, is performed for product acceptance, verification of product quality, and adequacy of the contractor's quality controls. Inspection is performed to the degree necessary to assure contractor compliance to related contractual requirements.
- **Contractor Decision Verification.** Contractor decision verification is the direct inspection of product characteristics, not covered during product inspection and test but subsequent to contractor inspection using contractor's inspection records, to determine and verify the accuracy of contractor quality and inspection decisions. Using a checklist, prepared earlier, designated product characteristics are inspected and results are compared to the contractor's inspection records on the same characteristics. Comparability is an indication that the contractor's inspection is effective.
- **Corrective Action.** Last but not least is corrective action. It is an essential element of any program. It is required of the contractor when any breakdown in his quality program occurs to assure that product quality is not compromised. In addition, it ensures that the correction precludes recurrence. Corrective action is applied to any of the elements of the DCAS Procurement Quality Assurance Program.

Operating procedures are developed to form the basis of continuing quality assurance functions. The procedures cover criteria for establishing the initial magnitude and frequency of continuing procedures evaluation, product inspection and tests, and contractor decision verification. Subsequent reduction or increase of effort in any PQAP element is based on past quality history, customer complaints, and confidence within that element, plus the effects of interrelating elements. Statistical quality control is used to maintain the required control of quality. A statistical plan is developed for the operating elements of PQAP. Statistical planning includes randomness, selection of characteristics, reduction and tightening of effort, review of contractor records, frequency, acceptable quality level, process average, etc.

Level of PQAP Application

In establishing the level of PQAP application, a definite relationship is recognized between the commodity being produced and the control system. The more complex the commodity, the more complex the assigned control system and the greater the number and importance of elements to be evaluated. Management controls over PQAP are maintained by a management information system. The information system provides the means for measuring PQAP effectiveness, as well as PQAP application.

This shift in quality assurance concepts has established the need for engineering capability in the DCAS Quality Assurance Directorate. As defense procurement patterns shift to still more sophisticated weapon systems, engineering qualifications in DCAS become critically important for accomplishing requirements established by buying activities. Future progress in space and defense programs depends on understanding and developing new materials and production methods. Modern electronic weapon and space systems, integrated circuits and other microelectronic items, whisker metallurgy (composites), laser beam welding, and other technological developments require high quality/reliability engineering competence to administer DCAS quality assurance programs. In many instances, normal controls over manufacturing processes and techniques are inadequate to assure that material of the required high standards of uniformity and reliability can be produced. Also, in a significant number of cases inspection requirements, as outlined in various military specifications, may not be sufficiently searching in character to assure that the necessary degree of perfection can be reliably achieved.

The level of quality and the effort needed to attain this perfection should be related closely to the fulfillment of the need. It is increasingly evident that we will find a growing need for optional provisions or addition to our specifications relating to specific contracts, which may result in establishment of more than one level of quality and intensity of inspection for some of our semi-finished or component products (Group B, C and D performance tests may be cited as examples). Achievement of this concept requires the exercise of engineering judgment on the part of the specification writer, the requiring activity, and the contract administration service, with close liaison among all three. Frequently the specification writer is remote from actual physical contact with the material for which he is specifying standards. Refinement of specifications is, therefore, almost completely dependent on the extent of communications to the specification writer from the end user who tells how well the product design meets the service need, and from quality personnel who judge the adequacy of the quality provisions in the specification.

The increased complexity of quality assurance functions have also been given substance in changes to the Armed Services Procurement Regulation (ASPR). ASPR 1–406 now prescribes certain engineering functions as normal DCAS performance. The introduction of engineering skills recognizes the increasing complexity of today's materials, equipment, and production processes. Engineering expertise is now essential in establishing and maintaining an effective quality assurance program for defense mission. At least six characteristics of today's defense procurements demand a heavy reliance on engineering capability. These are:

- Highly technical nature of many contracts.
- Lack of definitive quality requirements.
- Necessity for complex tests.
- Dependence on simulation and simulation methods.
- Compression of schedules and available time.
- Sophistication of weaponry tending to increase performance type contracts.

These characteristics reflect a significant advance in technology, and, consequently, affect quality assurance methods and concepts. Noting the shift in defense procurement patterns, DCAS has increased its engineering capability by 100 percent from its inception in January 1966.

In addition, the quality assurance management system continues to increase its reliance upon scientific management techniques. This is readily apparent in computer use, data feedback systems, communication networks, work measurement programs, and general use of engineering and operations research techniques. In order for the quality assurance program to keep abreast of these developments, the necessary professional skills with respect to both hardware and management systems are essential and must be present in the quality assurance organization. The introducton of engineering and special technical skills does not imply a change in the quality assurance mission or policy, but rather it should be noted that the function has grown quite complex and these skills are provided to increase the effectiveness and scope of operation of quality assurance.

The yesterday and today era of defense procurement quality assurance has shown the increased qualifications required by DCAS to accomplish this function. What can we expect in the future? What are the trends in commodities and technology? Which trends affect work force requirements? What will be the work force skills?

Tomorrow—Automation and New Technologies

Major advancements have been made in automation and development of new materials, processes, and testing techniques. The commodities of the future will be built automatically under extremely controlled conditions. New, more sophisticated numerically controlled machines will be developed for many of the commodities now requiring craft skills. This trend will continue as labor costs increase.

Computers will link the design phase directly with the production process. Today's concept of design/drawing/release/manufacturing cycles will no longer exist. With the tremendous growth predicted in technology, the engineer's role in controlling quality will be critically impor-

George G. Gula is Chief, Quality Assurance Engineering Directorate, Defense Contract Administration Services of Defense Supply Agency. He has 25 years experience with procurement quality assurance and as staff engineer. He holds a B.M.E. degree and has done post graduate study in industrial management.

tant. Less often will industry or the Government be able to place men in production lines to catch specification errors while the product is being manufactured. We must apply engineering talent *before* automated equipment is put into operation. End of line or complete item inspection will be impossible or too late. The item will be encapsulated, as in integrated circuits, or too far in production process for economical rework as in electron beam welding at 100 inches per minute fusion rate for ½-inch thick stainless steel plates.

Quality and design engineers will program the design into the computer with instructions for numerically controlled machinery. The computer will direct the operation of manufacturing processes, such as drilling, milling, boring, turning, assembly of microminiature components, or blending and compounding in the petroleum and chemical industry, etc. Quality assurance in the machine tool environment is normally performed by certifying with machine calibration during production at frequent intervals with a certified standard tape.

Figure 1 indicates the expected growth in the numerical control (N/C) machine tool area in industry. The statistics apply to the metalworking industry which utilizes numerically controlled lathes, boring machines, milling machines and other machines.

Many innovations in the numerical control field will provide for one system to operate as many as 256 individual machine tools (which may be of widely differing types) from the output of a single computer. Test equipment in this environment would be automatic and controlled by the computer. Equipment will be accepted by a review of computer controlled and printed test data.

The petroleum industry has been a pioneer in this field. The petroleum in-line blending system calls for blending six base stock components (platformate, alkylate, catalytic cracking, pentane, butane and combined raffinate and light). Also, the addition of anti-knock compound, two dyes, and two additives can be controlled to produce all of the gasoline production. Similar types of blending operation will be used for JP–4 and JP–5 jet fuels. Line analyzers with specially designed sensors analyze, print, and automatically control vapor pressure, octane number, API gravity, contamination, water content, and the like.

A project, sponsored by DCAS and selected oil refineries and pipeline carriers, is well underway to assure establishment of the proper quality assurance sampling techniques, acceptability standards, calibration, and controls of the automated in-line blending of JP–4 fuel. This concept most likely will revolutionize the present batch quality assurance techniques applied by the petroleum industry, with resultant savings in time, testing and manpower. Should this study prove that automated in-line blending is feasible, then present specifications, qualification procedures, American Society for Testing Material test methods and procedures, as well as procurement quality assurance provisions, will have to be revised to permit use of these new techniques. Foresight with objectivity is the motto, for myopic thinking during the study can be a deterrent to progress.

Electronic equipment will also be manufactured and tested under automated conditions. In-process controls and systems surveillance will be critical. Computers will sample plating techniques, etching processes, and control most machines involved in the production of microminiature chips, integrated circuits and thick and thin films. Again, acceptance will be by review of print-out test data as programmed by computer-controlled automatic test equipment. Toll gate inspection will be done with "go" "no go" tolerances by a computer programmed for acceptance or rejection. Product verification and visual inspection of today will become an item of historical significance. Product line certification will be the approach to accomplish the quality assurance mission.

Since quality cannot be adequately determined upon completion of the automated process, controls must be established and monitored during the production cycle. In future thin film (integrated circuit) manufacturing processes, parts will be welded together, moved through a heat treat operation, subjected to cleaning, processed through a plating line and, finally, packaged and identified for stock or shipment without benefit of stop-off points for product inspections. Throughout the production process, automatic process controls would be programmed so that the welding, plating, heat treatment and cleaning will be performed at proper temperature, strength monitored, time duration controlled, etc. In addition, automatic quality evaluations will be programmed to evaluate the quality of the weldment, plate, heat treatment, cleaning process, packaging, and design characteristics of the end item. Provisions will be for calibration of various sensors and evaluation of accuracy at predetermined frequency.

Already a study by the DCAS Quality Assurance Directorate and the National Aeronautics and Space Administration's Reliability and Quality Assurance Office is underway in product line certification for integrated circuit producers. The study will evaluate the manufacturer's ability to control his production processes; evaluate product test methods and results; and evaluate the detailed plan of how the product line will be maintained at its high-quality performance level. It is intended to expand the plan to other products.

Quality Engineering Knowledge and Skills Required

The days of the "old time" inspector are numbered. He will be re-

Numerical Control Machines in Use in Metalworking Industries*	Year
7,100	1965
10,000	1966
13,712	1967
14,943	1968
16,731	1969
18,750	1970
20,769	1971
22,766	1972
25,386	1973
28,006	1974
30,626	1975

*Source: *American Machinist*, November 18, 1968, for 1965-1968. Defense Contract Administration Quality Assurance Engineering Projection for 1969-1975.

Figure 1.

placed by a more highly trained and technically competent individual. DCAS quality assurance personnel, assigned to plants or facilities with significant automated process, will be quality engineers. To advance with the technology, the quality engineer must be trained in computer systems and applications, as well as in process controls and systems evaluation and control. Greater emphasis will be required on specialized experience and training in these areas, in conjunction with essential commodity and engineering discipline knowledge.

Computer Technology.

The quality engineer must have a knowledge of computer language, computer memory (storage), sequential (step by step) operations, and stored programs. Fortran or modified Fortran programming will be a prime technical tool of the quality engineer, since it can perform both arithmetic as well as mathematical operations, and can be programmed for manufacturing process control as well as scientific or engineering design and problem solving. The quality engineer will review the program to ensure it contains proper controls, tests, sensing devices, frequency of checks, control limits, and corrective action, and that process variables, etc., have been adequately programmed into the automated engineering process to assure quality and reliability of end items.

Process Engineering.

The quality engineer must have a good knowledge of process engneering to enable him to determine whether or not a manufacturing process includes necessary monitoring and control modes and to assure that proper alarms, restraints, or corrections have been programmed into the computer. In addition to knowledge of processing engineering, the quality engineer must acquire knowledge and experience in programmed control system feedback and corrective action. Corrective action may be automatic or an alarm system which signals need for manual adjustment or correction to bring the process within control limits. In addition, with visual presentation or printout of data, the quality engineer must be able to review raw data and computer output to detect when combination of controlled functions approach an "out of process control" condition. Then the engineer must be able to take action to assure the product is verified as being satisfactory. Process monitoring requires that the computer be programmed to establish:

- **Status of Equipment.** The computer will be programmed to monitor the status of various sensors and equipment, such as pumps, valves, motors, switches, interlocks, etc., in the processing system. Thus, safety conditions will be established to eliminate possible unwanted combinations of valve settings, interlocks, etc., and assure proper blending, compounding, machining, etc., of the end item. The computer also will be programmed to monitor flow, temperature and pressure measurements as well as wear of components, overheating, and excessive vibration of the equipment. In addition, leaks, such as steam, water, air, etc., in process equipment can also be programmed and monitored by the computer.
- **Instruments and Process Variable Monitoring.** The computer will be programmed to scan the various process sensing instruments. The program will do the scanning on a fixed frequency, or on demand by the operator, programmed conditions, or as required by the process itself. During the scanning process, the computer will perform various checks, such as proper instrument functioning, detecting controller failures, interpreting erratic readings by programming limits into the computer, and comparing the readings against these limits. These limits will differ from out-of-range (unusable) limits. In addition, cross-referencing will be programmed so that readings are cross checked with other readings, such as flow and pressure, which normally are interrelated.
- **Product Status.** The monitoring of instruments and process variables will be critical in an atuomated operation, since the data will be the only method available to determine in-process product quality prior to end item evaluation. The computer will receive quality data from testing stations in the test laboratory. Computations will be performed on raw data developed by various analytical devices, such as chromatographs, spectrometers, mass spectrometers, calorimeters, etc., to derive product information and compare with program standards. This will be the means by which quality engineers determine acceptable, usuable, or reworkable end items.

Statistical Concepts.

Different statistical concepts must be applied by the quality engineer in the various automated manufacturing processes for analyzing and interpreting test data, as well as control of the process. The normal inspection pattern of accept or reject may be applicable in certain processes; however, concepts will have to be developed and applied for making valid determinations of acceptable, unusable, or reworkable end items and then programmed into the computer. Determination of the limits and the programming into the computer will require the application of new statistical techniques, as well as unique application of standard techniques. The statistical applications will be:

- **Standard Statistical Techniques.** Application of standard statistical techniques will be used and programmed; however, the techniques will be used predominately to project average performance from a sample; to compare materials or products with average performance; to compare materials or products with respect to variability of performance; and to determine number of measurements required to establish the mean with prescribed accuracy. Uniqueness will be in the application of various standard techniques in programming the computer to act as the "inspector"

Bibliography of Additional Information

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in determining and maintaining control of the automated process.

- **Enumerative and Classificatory Data.** The simplest kind of classification, and the one most widely used in practice, is where results of the test on each item are recorded as pass or fail, larger than specification limit or less then specification limit, etc. Classification by size, color and structure, however, require three or more categories. For example, in classifying types of metal fractures, classes may be established as smooth, rough, jagged, etc.; glass or plastic material after exposure to radiation may be classified as transparent, translucent, or opaque. In the screening inspection mode of automated processes, we will have three established categories: acceptable, unusable, or reworkable. The Chi-Square Test of statistical concepts can be used to determine whether there has been a production process "shift" by comparing the data generated by a given quantity of material with a programmed standard (known distribution of previous material). The computer would indicate that further analysis is required to determine the cause of the "shift." Statistical analysis of tolerances would be programmed and used to determine whether a particular item (or range of items) should be reworked, scrapped, or considered usable.

- **Comparative Experiments.** In many industrial processes, there is a measurable end property whose value is of primary interest and which should attain some optimum value. This end property is known as yield or response. For example the end property might be strength, or some chemical or physical characteristic that would be most desirable at a maximum or at a minimum. Naturally, the value of this primary end property will depend upon the values of the factors in the process which affect the end property. These values will be developed and programmed into the computer to control the optimum response or output of the process. In addition, the amount of change in response that results from small deviations from optimum settings will also be developed and programmed. Thus, process control limits will be established. By use of the factorial experiment statistical concept, a chemical process, wherein time, temperature, pressure, amount of catalyst, purity of ingredients, etc., are the controlling factors, will be programmed for establishing the values of the variable factors to obtain optimum response as well as the allowable deviation from optimum for control of process.

- **Non-Standard Statistical Techniques.** In an automated process, short-cut tests will be programmed for "quick and dirty" checks. Typical queries to the computer will be: Does the average of the new product differ from the standard? Does the average of the new product exceed the standard? Is the average of the new product less than the standard? Typical application of short-cut tests will be, for example, in the transistor area of "reverse bias collector current" of an automated production process, wherein the actual and running average is compared continuously with established standards as to conformance, exceed, or less than the standard. The Sign and Wilcoxon—Signed Ranks Test illustrates this concept and will be programmed into the computer. In addition, comparison type tests may be programmed to determine the comparability of two different manufactured transistors of same type designation.

As computer techniques become more sophisticated in their applications in the manufacturing process, statistical techniques utilized in conjunction with the computer will also become more sophisticated. Future statistical techniques will tend to be refinements of present day statistical tests, such as Chi-Square, Student's "t", Kolmogorov-Smirnov (k-s), etc.; and other high powered statistical techniques, such as, math-modding analysis of tolerances, design of experiments, etc. Thus, presently unmeasurable quantities can be computed by the computer from other variables which can be measured. This is known as indirect or inferential measurement, and requires equations which relate the desired unmeasurable variables to available measured quantities.

Instrumentation Concepts.

The quality engineer must have knowledge and experience in computer instrumentation concepts. Instrumentation of an automated process is critical. Monitoring, testing, and controls of the process are based on the various sensing devices used throughout the process. Prior to the advent of the computer, most instrumentation was of direct reading type (pressure gauge, voltmeter) requiring only the calibration of the instrument. A process measurement for input to a control computer requires a transducer, a means of transmission to the computer, and conversion to computer language for final sorting and use by the computer either as a visual presentation, printout, or comparison with specified limits.

- **Transducer Technology.** Transducer technology involves the selection and application of suitable devices for sensing some physical property critical to the process monitored. The transducer is a sensing element that receives energy from the medium monitored. The sensing element may be thermal, mechanical, pneumatic, electrical, or acoustic, depending upon the medium and measurement to be monitored. Output of the transducer must be converted or amplified to a suitable form and level to be fed into the computer. Thus the quality engineer must possess knowledge of and experience with numerous sensing devices, conversion means, and amplifying circuits such as thermo-couples, Bordon tubes, analog to digital conversion devices, differential amplifiers, etc.

- **Error Analysis.** The quality engineer must have a knowledge of error analysis. This is necessary for calibration purposes. Errors may be categorized as equipment error, transmission error and human error. Equipment error will be in the sensor, conversion and amplifying devices as well as in the computer system (input devices, recorder, arithmetic or mathematical unit). A sensor extracts some energy from a measured medium. The measured quantity is disturbed by the act of measurement, making a perfect measurement impossible; thus, error is induced in the measurement. Transmission error must also be considered and is normally found in two areas: noise interference and transmission line impedance losses (resistance, capacitance, inductance). In addition, consideration must be given to time of transmission, even though in nanoseconds, from sensor activation to computer evaluation. This is essential for control purposes, otherwise reworkable or unusable material may result. Last but not least, consideration must

(Continued on Page 36)

FROM THE SPEAKERS ROSTRUM

Steps To Improve Weapon Acquisition Process

Charles L. Poor is acting Assistant Secretary of the Army (Research and Development). Prior to his nomination, he served as Deputy Assistant Secretary in the same office. Secretary Poor has been a career scientist since 1945, when he joined the Ballistic Research Laboratories, Aberdeen Proving Ground, Md. He holds an A.B. degree in aeronautical engineering from Harvard University.

Address by Charles L. Poor, Acting Asst. Secretary of the Army (Research & Development), before the Pittsburgh Chapter of the American Ordnance Assn., June 25, 1969.

The Defense Department, its laboratories and its contractors have been coming under increasingly severe public scrutiny in the acquisition of new weapon systems. We are told each day in the press of some new evidence of allegedly uncontrolled overruns in the cost of new weapons and vehicles for our Armed Forces, and there are dark rumblings about vast unearned profits and drastic deficiencies in the products we are giving our troops. It seems, therefore, appropriate to spend some time talking about the weapon systems acquisition process, to discuss with you the roles of Government and industry as they work to provide for our taxpayers the things we need for our defense.

The role of the research and development management offices in DOD and the Services is, first and foremost, to provide for the citizens of the nation the opportunity to obtain, promptly, those weapons and equipments best suited to the needs of national defense. I stress the word opportunity. It does not make sense to build up arsenals of expensive equipments beyond our real needs. Our inventiveness, our wealth of industrial capabilities, and our competitive system of free enterprise, together with the fruits of an exploding science-based technology, give to the Services a vast number of attractive proposals for development.

But it is clear that we cannot reasonably attempt to carry through to development and deployment all the attractive schemes for new systems. Just because a very difficult, expensive, challenging project seems possible, and many (or some) people badly want to do it, is not, in itself, a sufficient reason for its undertaking. There has to be a better reason for allocation of national resources.

Develop the Research Base

So, one of the first jobs of the Director, Defense Research and Engineering, and of the research and development management groups of the Military Services, is to nurture the research base that keeps the new ideas flowing and to carry them far enough to decide, rationally, if it makes sense to go further. In doing this it is inevitable that many ideas get carried part way through development, and then are dropped or set aside because the capability offered is not worth the cost, or because a better, new idea comes forward that allows a simpler way of meeting the military threat. When we go too far with a development that is too expensive for us to afford to buy in the quantities needed for the military job to be done, we have wasted resources. When we fail to carry a proposal far enough to permit a realistic assessment of its military potential, we may have missed an important opportunity to save money, and human lives, and human effort, through new technology.

In this business of initial choice, I think the record is fairly good. We have started many projects that we have stopped early in the development cycle, because it had become clear that they could not sensibly claim the resources required for deployment. None of the ABM deployment proposals of the early 1960s could meet the test of economic reasonableness or of cost-effectiveness. The continuing research program in ABM technology did lead us to today's situation, where we know how to build a system that will work against many of the threats we see. We can today seriously and sensibly propose a significant improvement in our strategic posture, at a cost we can well afford. We can build with this technology a set of defense options to counter newly evolving threats—options which can safeguard our country and which offer the hope of slowing the offensive arms race through substituting defense for the unhappy alternative of further proliferation of strategic offensive forces to counter growth in enemy offensive capabilities.

The list of technical advances is long, and one of which both DOD and American industry can be justly proud. The military capabilities these advances offer are impressive and, prudently chosen and carefully developed, should lead to the kind of security through strength and technical excellence we owe the nation.

The Cost Problem

Nevertheless, there is a developing concern in the Congress, in the press, and in the minds of the public at large about our stewardship. We are reminded of cost overruns on major weapon system procurement, with example after example of systems whose cost exceeded by large amounts the initial estimates. We see, at the same time, many examples of loss incurred by defense contractors on projects thought to be well defined. It seems apparent that something is amiss—that our methods of doing business need to be re-examined and refined.

History is sometimes helpful in gaining perspective. The weapon designers and producers of the 1950s were almost completely preoccupied with the problem of performance. The Harvard Weapons Acquisition Research Project in 1962 studied 12 major systems, including Atlas, Polaris, Nike, B-58, and F-105. They concluded that, on the average, performance exceeded original predictions. However, performance was achieved at the expense of the other two objectives of the acquisition process. Actual development time averaged 36 percent greater than predictions and cost increased an average of over 200 percent and, in some cases, as much as 7 times original estimates. It seems clear that, if we are willing to spend enough time and money, we can solve almost any technological problem. A current example is the Apollo program. The application of large amounts of resources to the specific problems of landing a man on the moon has resulted in the solution of tremendous technical problems much more rapidly than most people a very few years ago would have believed possible. Even the program's severest critics must admit that it has been an outstanding technical achievement. However, they ask the question, "Is it worth the cost?"

Secretary McNamara asked the same question about the weapon systems of the 1950s—when he bebecame Secretary of Defense in 1961. There have been periods when the national defense has been so critical that, to use a time-honored cliche, "money was no object." World War II was such a period. There may again be times the country must spend whatever is necessary to assure success.

The same thing can be said for certain specific weapon systems. The invention of the bow and arrow made it impossible to survive using clubs. After gunpowder became available, a nation could no longer survive by relying solely on bows and arrows. It was considered absolutely essential that this country develop the atomic bomb, regardless of cost. The ballistic missile and Polaris submarine *may be* in the same category. However, weapon systems of this importance do not come along very often. This philosophy was being applied to too many of our weapon systems in the 1950s and this caused a reassessment of our acquisition process.

Some of the things we did in the early 1960s to correct this were:

- Costs were made equal in importance to performance and schedule in the normal program, as a matter of policy.
- Elimination of "gold plating" was made a policy goal.
- Increase in competition was made a policy goal.
- Reduction in the use of cost-type contracts, particularly cost-plus-fixed-fee, was made a policy goal.
- Concept formulation and contract definition procedures were established.
- A broad range of system analysis studies to aid the decision-making process was established.

In the current review of the acquisition process, we have seen some results of the changes instituted in the post-1961 era. A recent review of seven major weapon systems programs indicates that while final costs will exceed initial cost estimates, the increases are dramatically less than in the 1950s. The average increase is less than 40 percent of the 1950 experience. While this is encouraging progress, there is clearly more to be done.

Although the concept formulation and contract definition procedure have not produced all the results we hoped for, they have contributed significantly to improving the acquisition process.

Purpose of Concept Formulation

The real purpose of concept formulation is to assure the following before starting contract definition:

- The mission and performance envelopes have been defined.
- A thorough tradeoff analysis has been made.
- The best technical approaches have been selected.
- Primarily engineering rather than experimental effort is required in the remainder of the program and that the technology needed is sufficiently in hand.
- The cost effectiveness of the proposed item has been determined to be favorable in relationship to the cost effectiveness of competing items on a DOD-wide basis.
- Cost and schedule estimates are creditable and acceptable.

The purpose of contract definition is to:

- Verify that only engineering development remains ahead.
- Establish realistic and firm specifications, schedules, and cost estimates.
- Identify possible risk areas.
- Obtain a signed contract, preferably in the presence of competition and preferably on a firm-fixed-price basis.

As most of you know, all of these objectives have not been met in all of our concept formulation and contract definition projects. I believe that this was primarily because we relied too heavily on paper studies in place of testing hardware. You may remember one of the catch phrases of the early 1960s: "paper costs less than metal." Of course, this does not recognize that the results of paper studies are often less reliable than they appear. While it is true that cut-and-try methods unsupported by a rational plan can be very expensive, so can beginning full-scale engineering development on the basis of a paper plan without experimental resolution of the high-technical-risk elements in the program.

To many people "gold plating" means adding cost to an item without adding utility. A broader definition would include adding utility to an item, but not commensurate with the adding utility. A broader definition defense program. We have made substantial progress in the first area, but we have a little further to go in the second area.

Competition in the Defense Market Place

Competition has an important place in the weapon system acquisition process just as it does in the civilian economy. But, there are important differences in the competitive environments of the defense and civilian economies.

The first difference concerns the number of customers. In the competition between Ford and Chevrolet there are millions of customers. The fact that I might buy a Chevrolet is not a major concern for Ford. Barring a catastrophic mistake in design, the sales of a particular automobile will not vary more than a few percentage points per year, thus, assuring the recovery of most, if not all, of the investment. On the other hand, in the defense economy the Defense Department is generally the only customer for a weapon system. Sometimes there may be a civilian market for a related item or a foreign military market. However, these secondary markets are not normally large enough to justify undertaking development of the weapon unless the Defense Department buys it. If *the* customer does not buy the product, not only is there no profit but practically all of the investment may be lost. The all-or-nothing nature of the defense market has an important influence on the other major differences in the two environments.

The second difference between the civilian and military competitive environments is the time in the life cycle of an item at which the competition occurs. Both Ford and Chevrolet have automobiles in the dealers' show rooms where the customer can slam the door, kick the tires, and test drive the actual item he will receive before he makes a commitment to buy. For a major weapon system, the military customer is usually given a blueprint, an artist's concept, and a long list of specifications of the item the contractor proposes to produce. Sometimes he is shown an engine running on a test stand and new transmission that will be used in his "car." Seldom are these components hooked together into a protoype that the customer can test, and almost never is the military customer able to test drive the actual item he will receive before he makes a commitment to buy it. In one instance, we have a hardware competition at the end of production and, in the other, it is essentially a paper competition before development begins. Because of the sudden-death nature of the competition in the defense environment, there is reasonably strong motivation to be optimistic in predicting the performance capabilities of the paper item.

Because of these differences in the two competitive environments, the Defense Department must be careful in its approach to the acquisition of major weapons. The controls normally provided by the competitive process are no assurance of success.

Improving the Acquisition Process

I have said that things were not so good in the 1950s, and that they are much better in the 1960s. Now I would like to talk about some tentative ideas as to how we might make them even better in the 1970s. Several very competent groups have been studying the weapon system acquisition process, trying to devise ways of improving it. The Aerospace Industries Association (AIA) Technical Council and Procurement and Finance Committee published a report in November 1968 in which it identifies the difficult problems caused by "unknown unknowns" in research and development programs. A panel of the Industry Advisory Committee and a task force of the Defense Science Board are in the final stages of studies on this subject. Many of the following ideas came from discussions within these groups.

The problem that is receiving the most attention at the moment is "cost overruns." First, we must define what is meant by the term "cost-overrun." The press generally defines it as the difference between the initial cost estimate and the final actual cost of a program. Such a definition does not recognize the quite different elements making up the total price differential. The first element is the cost increase associated with the work specified in the original program and not attributable to inflation. The second is cost of additional work not included in the original program. The third is the increase resulting from inflation. In my opinion, only the first element of cost increase should be considered a cost-overrun.

Cost increases are not unique to weapons programs. They frequently occur in areas that we know much more about than we do in research and development projects, as anyone who has built a new house recently is probably well aware. However, since we may be talking about billions of dollars in defense programs, they are much more difficult to deal with.

During World War II we spent as much as 41.5 percent of our annual Gross National Product (GNP) on national defense. In the Korean War a little over 13 percent of the Gross National Product was devoted to national defense. In 1968, the figure was 9.1 percent. Although we are spending a relatively small percentage of the GNP for defense, we must consider not only what the country can *afford* to spend, but also what it is *willing* to spend. The prices of weapons have increased so much in the last two decades that we must face the very real possibility that we may price ourselves out of the market.

The M-48 tank cost $110,000. The estimated cost of the Main Battle Tank is in excess on one-half million. A conventional anti-tank round costs from $50 to $100. The Shillelagh costs over $2,000.

Even though the new weapons are much more effective than the old ones, we must recognize that we are competing with potential opponents in terms of numbers of items as well as quality of performance. The Main Battle Tank may be 10 times as effective as the M-48, but it cannot be in 10 places at the same time. With today's prices, we cannot expect, nor do we always need, a one-for-one replacement of the old weapons. However, there is a minimum number we can accept and we must be sure the total price for the inventory is not unacceptable.

What we must seek is to avoid, on the one hand, development of systems in which cost is so important a consideration that the benefit of advances in technology is denied our forces and, on the other hand, the evident danger of adding sophistication to obtain marginal increases in performance at a price we cannot afford. Design for maximum effectiveness within an overall system cost constraint should give the designer the freedom he needs to trade off numbers against sophistication.

One approach to obtaining better design solutions might be for the Government to specify, in advance, the maximum total price we feel is appropriate to pay for the capability of meeting an expected threat with a new weapon system.

Within that total the designers would be free to seek a solution that would maximize the effectiveness, comparing large numbers of simple, inexpensive weapons against smaller numbers of more sosophisticated designs with higher unit effectiveness and higher unit costs.

To provide a better base for more accurate cost estimates and for management decisions, I recommend the scope of concept formulation be expanded to include sufficient hardware development and testing to resolve most of the technical risks before entering full-scale engineering development. If it is economically feasible, we should complete a competitive parallel development and testing program of prototypes by two or more contractors as a basis for selecting the development and production contractor.

A prototype testing program prior to entering engineering development should eliminate most of the "unknown unknowns" described by the AIA study and, in turn, should make the coupling of development and production into a single program less prone to difficulty than it is at the present time. As you know, our policy is, *other things being equal,* to award contracts to the lowest responsive bidder. Since there are usually at least two technically competent competitors for a major weapon system contract and it is the only game in town, there is considerable pressure to be low bidder. Under this pressure, the contractor must plan efficient application of manpower and facilities over the entire life of the contract, with minimum provision for unexpected difficulties. If an "unknown unknown" disrupts the schedule, serious cost overruns can be anticipated. Elimination of unknowns before we establish a firm production program seems essential to good planning, both for the Government and for our contractors.

To assure that we do not go too far too soon in major weapon programs, we should identify at the beginning of the program those things that are critical to each phase of the program. The contractor and project manager would be required to furnish proof of having accomplished each milestone to secure approval to proceed to the next phase of the program. It might even be practical to tie release of funds to the successful completion of key milestones. Such an arrangement would, of course, have to be adequately covered in the contractual arrangement. If the check points are established properly, we should be able to avoid premature production commitments, and the costs incurred, should the development program require significant changes in design.

Acquisition Review

The Deputy Secretary of Defense recently established a Defense Systems Acquisition Review Council within the Office of the Secretary of Defense to advise him of the status and readiness of each major system to proceed to the next phase of effort in its life cycle. The council will evaluate the status of each candidate system at three basic milestone points:

- When the sponsoring Service proposes to initiate contract definition.
- When it is desired to go from contract definition to full-scale development.
- When it is desired to transition from development to production.

The membership of the council will include the Director of Defense Research and Engineering, Assistant Secretary of Defense (Installations and Logistics), Assistant Secretary of Defense (Comptroller), and Assistant Secretary of Defense (Systems Analysis). The Director of Defense Research and Engineering will chair the council for the first two reviews and the Assistant Secretary of Defense (Installations and Logistics) will be chairman for the transition to production review. The Deputy Secretary of Defense specified that primary responsibility for the acquisition and management of major systems will remain with the individual Services.

In closing, let me emphasize that major improvements in the weapon systems acquisition process can only come about through close cooperation between Government and industry. Your advice is always welcome, and together we should be able to make a good system of procurement even better.

Needed: Transportation Engineering Standards

Address by Maj. Gen. Clarence J. Lang, USA, Commander, Military Traffic Management and Terminal Service, before the Cooperative Societies Luncheon, National Meeting on Transportation Engineering, American Society of Civil Engineers, Washington, D. C. July 24, 1969.

Being invited to address such a distinguished group of engineers is a real privilege indeed. I am aware of your many talents and accomplishments and I am mindful of my responsibility to present some thoughts worthy of your time and interest.

This is my first public appearance in Washington since assuming command of the Military Traffic Management and Terminal Service (MTMTS) in April this year. In preparing for this occasion, I consoled myself with the thought that whatever I say, I can't go wrong. After all, we are the customer and the customer is always right.

Actually though, we are customers of yours indirectly. You design and build transportation equipment and facilities for the commercial carriers, among others. We, in turn, use the equipment which in a sense makes us your customer, too. This is especially significant when one takes into account the fact that MTMTS is perhaps the world's largest purchaser of commercial transportation. While we do not actually spend the money, we do prescribe how it will be spent. This amounts to more than $2 billion a year.

Like all good shoppers, we try to get the most for our money, but price is not always the determining factor. Our job is to assure that all defense transportation requirements are met. Any genuine requirement must be met —at any cost—and we must do it within available resources. The critical test in the choice of modes or routes, then, is "will it get the job done?" Indispensable considerations in our business are deliveries at the right time, in the right place, in the right quantities, and in good usable condition. Any procurement failing to meet any one of these criteria is no bargain. More than that, it is a waste of time and money.

The transportation we prescribe for use, therefore, is that which is best designed to meet these requirements most effectively and most efficiently. The cost is considered within this framework.

The objective of my comments today is not to exercise a customer's inalienable right to be demanding, but to explain some of our problems and encourage your help.

Single Manager Land Transportation

First, and before I discuss transportation engineering, I should like to tell you a little about our organization and why the transportation purchaser is interested in transportation engineering.

Responsibility for military transportation requirements is divided among three single manager transportation agencies. The Secretary of the Navy is the single manager for ocean transportation. The Secretary of the Air Force is the single manager for airlift service. The Secretary of the Army has single manager responsibility for military traffic, land transportation, and common-user ocean terminals in the continental United States.

MTMTS, as the single manager operating agency for the Secretary of the Army, has a wide variety of responsibilities which fall under the umbrella of transportation. They include arranging for movement of troops and their weapons, munitions and material; world-wide responsibility for the movement of military dependents and personal property (household goods, baggage and house trailers). They include responsibility for providing common-user ocean terminal service within the United States to all military components—the Army, Navy, Air Force, Marine Corps, Defense Supply Agency, and other elements of the Defense Department. They include administration of the DOD Highways for National Defense Program. They also include certain transportation engineering functions.

To perform these responsibilities and functions, the current MTMTS organization consists of two area commands and one subordinate agency:

- Eastern Area, located at Brooklyn, N.Y.
- Western Area, located at Oakland, Calif.
- Transportation Engineering Agency, located at Fort Eustis, Va.

MTMTS is somewhat unique in that it is the only DOD transportation single manager agency that is jointly staffed, and has on its staff Army, Navy, Air Force, and Marine Corps personnel. It has an authorized personnel strength of approximately 7,000, of which some 6,000 are civilian employees. About 600 personnel are stationed at the MTMTS headquarters, located at Nassif Building in Falls Church, Va., near Washington.

During FY 1968, we directed the spending of DOD transportation funds in excess of $2.2 billion. Of this, approximately $1.9 billion was for the shipment of material and the remainder was for the movement of personnel. During the same period, we outloaded 19.7 million measurement tons of cargo, of which 2.5 million measurement tons were ammunition.

Objective

In managing such a workload, we are guided by three primary objectives which are spelled out in the MTMTS charter:

- To eliminate duplication and overlapping of effort by and among the Military Departments, Defense Agencies and other DOD components.
- To improve the effectiveness and economy of transportation operations throughout the Defense Department.
- To ensure that the approved emergency and wartime transportation requirements of the Defense Department are met.

It is the second objective—improvement of the effectiveness and economy of Defense transportation operations—that I wish to emphasize today.

With few exceptions, in the continental United States we depend upon the commercial carriers for our strategic transportation requirements. So you see, as one of the largest purchasers of transportation, we have a vested interest in the economy, efficiency and quality of transportation: economy from the standpoint of serving the taxpayer's interest; efficiency from the standpoint of timely delivery to those who are serving our country and our freedom-loving allies throughout the world; and quality from the standpoint of safety, dependability, and superior service.

These are attributes that can be accomplished only insofar as they have been engineered into the total transportation plant. We, in MTMTS, are assigned the implementing responsibility for the DOD interest in land transportation. Our MTMTS mission, therefore, is not just a matter of land traffic management and the operation of military ocean terminals, but includes the transportation-oriented portion of transportation engineering.

We consider transportation engineering to be a most significant part of our mission. In our Transportation Engineering Agency at Fort Eustis, we make numerous studies through which we are constantly striving to increase the strategic and tactical mobility of the Army in the field. Our tools include the application of traffic engineering techniques, more accurate transportability criteria for research and development, and better transportation guidance. Simultaneously, the agency produces guides for accomplishing these objectives at reduced or the lowest acceptable costs. In terms of increased efficiency, increased effectiveness, and greater economy, unquestionably transportation engi-

Major General Clarence J. Lang, USA, has been Commander, Military Traffic Management and Terminal Service, since April 29, 1969. Among his previous assignments, he was Chief of Staff, U.S. Army Materiel Command, and Director of Logistics, U.S. Strike Command. General Lang holds an M.B.A. degree from the University of Texas. He is a graduate of the Armed Forces Staff College and the Industrial College of the Armed Forces.

neering is the area where you strike "pay dirt."

Now, what is meant by transportation engineering? It seems that different people use the term, transportation engineering, to mean different things. All branches of professional engineers speak of transportation engineering. Universities offer much the same specialized courses, but also call them transportation engineering. One gets the impression the term is used to mean all things to all people. Maybe this is good, maybe this is as it should be.

However, if I may, I should like to raise this question: "Would it not be helpful if, by a joint effort of the interested technical societies such as are represented here today, there were developed some disciplines, some guidelines, and some objectives or targets to shoot at?"

With this thought in mind, let us examine the subject from the military transportation point of view and determine what transportation engineering means to us in the Defense Department.

Evolution of Need for Transportation Engineering

During World War II, the first Chief of Transportation, Department of the Army, learned that he had to do many things in order to provide effective transportation support, things that the construction agencies and commercial traffic people did *not* do. These included such things as estimating the capability of a given highway or highway network to support desired military operations. More specifically, he had to determine what were the limiting characteristics of the transportation systems. He had to find the answers to such questions as:

- What tonnage could be delivered over the highway or railroad network with normal maintenance?
- What were the size and weight limitations of our railroads and highways for movement throughout the United States and also overseas?
- What was the relationship between legal limitation and the scientific and safe limitations of existing bridges and highways?
- What were the working capacity and limitations of various ports and ocean terminals?
- What tonnage could be moved through them?
- What types of roads and railroads were required for efficient movement of peak loads which would be generated by various types of new military installations, industries and activities?
- What types of equipment were required for most effective operation on the transportation right-of-way available in foreign areas?

Since World War II, other transportation problems have challenged the Defense Department. These problems are the result of major changes which have taken place since that time in both *what* is to be shipped and the *techniques* for shipping. These changes include the great increase in the military arsenal of sensitive material such as missile guidance systems, major increases in the type and severity of hazardous materials, and the great increase in the use of *intermodal* transportation.

More specifically, as a user of transportation, we now have a greater need to know what are the critical environments inherent to each mode of transportation and related terminal operations. What shock and vibration forces are transmitted to the cargo during normal operations and during accidents? What are the heat, cold, humidity and atmospheric pressure variations due to normal weather as well as to equipment and operating practices? What are the critical physical and geometric limitations for intermodal transportation?

We know a lot about these environments and characteristics, but our knowledge is in little bits and pieces distributed among many people. The information has not been brought together as a reproducible performance standard that can be used to classify hazards, to design packaging, restraining and buffering techniques and devices. Such performance standards would also provide the basis for establishing test procedures. It was this need for such information during and after World War II that led to the development of a transportation engineering program in the Department of the Army. This need also led to a delineation of what we mean by transportation engineering, *i.e.*, different from "construction and maintenance engineering." Accordingly, the *Dictionary of U.S. Army Terms* includes the following definition of transportation engineering:

> **The science of evaluating the requirements for and planning the layout and functional aspects of transportation facilities; and of developing the most efficient relationships with respect to transportation equipment, transportation facilities, and traffic movement patterns so as to insure adequate, safe, and efficient movement by all modes of transportation.**

You will note this definition is operational or traffic engineering in character. It pertains to the dynamic and environmental aspects of transportation. It requires the identification and definition of the limitations of transportation systems. It presents the need for establishment of transportability criteria or transportation standards that are reproducible, and the development of tests to reproduce the environment in which things must live while being transported. It leads to the identification of all unacceptable restraints to efficient and effective transportation and planning system development, so as to eliminate or reduce them. It is bringing about these relationships that will enable realization of maximum benefits from all transportation systems to meet the needs of the national economy and the national defense.

Thus it can be said that transportation engineering, as we in the DOD know it, has to do with defining and improving the quality of transportation and the effectiveness of the service the transportation systems provide.

As a result of the continuous stream of new problems and our World War II experience, a study of transportation engineering in the Defense Department was made by the Military Services. The objective of the study was to determine what should be the role of transportation engineering in the Defense Department and who should perform the functions.

The study was made with the full participation of all the Military Services. Agreement was reached at all levels. With respect to who should perform the functions, the study stated that the functions necessary for accomplishment of the objectives are oriented to military materiel and transportation systems. It was the feeling of the study group that this provided the most logical and effective foundation for organization within the Defense Department. Accordingly, the *materiel-oriented functions* should be performed by the materiel development commands of each Military Service for the materiel each is developing. The *transportation-oriented functions* should be performed for all Services by each transportation single manager for the transportation systems and related terminals for which each has been assigned single manager responsibility.

These single managers, as I have already pointed out, are the Secretary of the Army, the Secretary of the Navy, and the Secretary of the Air Force. Very simply, it places responsibility where the expertise is, and provides for maximum coordination among the Military Services to ensure that intermodal aspects are fully considered.

DOD Directives

Since the submission of the Military Services' study to the Office of the Secretary of Defense, two new DOD directives have been issued. One [DOD Directive 5160.60] updates an earlier directive and deals with highways to meet the needs of national defense. It sets forth policies and responsibilities, and assigns authority, in matters pertaining to highway needs during peacetime and emergencies in the United States, its territories and possessions. It implements the transportation engineering definition referred to earlier with respect to public highways.

The second directive [DOD Directive 3224.1] provides for a relatively new program called "Engineering for Transportability." Robinson Crusoe, as you will recall, ran into trouble because he had not thought about "transportability." The raft he took such pains to build could not be moved to the beach. History is replete with examples of similar experiences. It happens all the time. The perennial predicament of "building a boat in a basement" is always with us. This second directive, therefore, sets forth policy guidance and assigns responsibilities for assuring that items of materiel and equipment are so designed, engineered and constructed that the required quantities can be efficiently moved by all modes of transportation. Of major significance, it directs, among other things, the accomplishment of three tasks requiring intra-Service coordination:

- Issuing, under the sponsorship of the appropriate Military Department, joint transportability criteria covering all modes of transportation and terminals, as well as the pertinent characteristics of transportation equipment.
- Ensuring that the transportability of new materiel is determined by field testing during the research, development, test and evaluation programs.
- Issuing, under the sponsorship of the appropriate Military Department, joint transportability guidance for military materiel.

The requirement for defining transportability criteria presents a most difficult problem. As you know, it is not too difficult to test something when test criteria and test procedures have been established. Also, it is not too difficult to provide transportability guidance for the [soldier] on such things as loading, blocking, bracing, lifting and sectionalization when the item is designed to meet transportability criteria and has been field tested. But, those of you who build our transportation facilities, those of you who build transportation equipment, and those of us who are responsible for providing a transportation service have not established criteria that defines and describes the transportation environment things must live in while being transported. Nor has anyone established measurable standards by which these environments can be reproduced for testing.

Unquestionably, it would be helpful if, by a joint effort of the interested technical societies, there were developed some disciplines, some guidelines, and some objectives. I recognize that this is a two-way street and that all of us must contribute to setting specifications for the requirement.

How can we expect the hardware research and development people to do a good job with respect to transportation of the end item if we do not tell them what the environments are, and if we do not furnish them test procedures so they can ensure the hardware is transportable? Also, how can anyone economically design packaging and restraining devices until we have defined the nature and magnitude of forces that will be transmitted to the package and the item?

Problems in Setting Standards

We might ask ourselves, "Why haven't standards or criteria been established?" I do not believe anyone can answer this question fully, but I believe there are at least two contributing causes:

- It is an extremely complex and difficult subject. As a result, a non-engineering operational experience approach has been used. That is to say, the total environment has not been broken down into parts that can be resolved by engineering analysis.
- Uninformed people are afraid of standards because they think they will be restrictive. I am fully convinced that the opposite is the case. I have never known a situation where additional knowledge developed by dependable, thorough, and intellectually honest people hampered or restricted progress. On the contrary, knowledge is the only basis on which we can grow and provide a better transportation service for the manufacturer, the shipper, the user, and the public.

In order that there be no misunderstanding, let me repeat what I said earlier. A lot is known about the transportation environment, but it is known in little bits and pieces, known to many individuals. It has not been brought together and set forth as standards or criteria for guidance to those who must use the transportation systems. Let me also make it clear I fully realize that if it was easy, it would have been done a long time ago.

The recent efforts of the Department of Transportation, with the assistance of the National Research Council's Highway Research Board and the Committee on Hazardous Materials, to learn what is available and what needs to be done to improve the transportation of hazardous materials is commendable. Although this is only one area among many that need to be explored from the standpoint of the item being shipped, the transportation engineering information on environments has application to all commodities, and the possibilities for improvement are great.

In order to present some thoughts worthy of your time and interest here today, I have discussed some of the things the users and purchasers of transportation need so everyone can do a better job. As purchasers of transportation, we at MTMTS are aggressively working at transportation engineering day-by-day and are providing related land transportation services to the entire Defense Depart-

(Continued on Page 36)

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(Continued on Page 23)

Keeping Pace with Change

Lieutenant General John S. Hardy, USAF

In today's fast-changing world, the managers of our resources for national security must think clearly and dispassionately, examine alternatives and make decisions from broad points of view based on knowledge in a wide range of fields. The Industrial College of the Armed Forces (ICAF), located at Fort McNair, Washington, D.C. 20315, has been turning out just such leaders through educational programs that are designed to meet the increasing demands of change and of rapid technological growth.

As the pace of change has quickened, our curriculum planners have looked more and more to the future in refining all three of the college's educational programs—the resident course, the National Security Seminars, and the world-wide correspondence program. It is my purpose here to focus attention on the present status of the correspondence program and on some of the new directions in which it is heading.

On Feb. 25, 1969, the Industrial College celebrated its 45th anniversary. War Department General Orders No. 7, dated Feb. 25, 1924, had established the Army Industrial College, under the direction and control of the Assistant Secretary of War, "for the purpose of training Army officers in the useful knowledge pertaining to the supervision of procurement of all military supplies in time of war and to the assurance of adequate provision for the mobilization of materiel and industrial organizations essential to war-time needs."

Almost from the first, the college drew students and faculty from the Navy and Marine Corps, as well as the Army. In April 1946 it was renamed the Industrial College of the Armed Forces, in recognition of its inter-Service character. In September 1948 it was formally reconstituted as a joint educational institution operating under the direction of the Joint Chiefs of Staff.

The mission given to the college 45 years ago has been broadened and developed until today the college stands as the capstone of the military educational system in the management of resources for national security. Its present charter specifically directs the college:

> **To conduct courses of study in the economic and industrial aspects of national security and in the management of resources under all conditions, giving due consideration to the interrelated military, political and social factors affecting national security, and in the context of both national and world affairs, in order to enhance the preparation of selected military officers and key civilian personnel for important command, staff and policy-making positions in the national and international security structure.**

The scope of the charter reflects the changes that have been taking place since World War II in the form and nature of the nation's military institutions, and in most aspects of its national security. Leaders in this field must have some grasp of developments on all fronts, and thorough understanding of developments on many fronts. These developments include: the ever-changing technology of weapons and their impact on tactics, strategy, and logistic support; innovations in organizations and techniques for control and management; the increased influence of international organizations and staff structures; developments in emerging nations; even the involvement of the defense establishment in the domestic scene. These developments have vastly extended the range of interest of the military professional and have placed increasingly challenging demands on our educational programs.

The ICAF Schools

At the heart of the activities of the college is the 10-month resident course, offered each year to 180 selected military officers and government civilian executives. The Resident School uses the term "management of resources" broadly. The school emphasizes the knowledge and skills required for effective decision making at the highest levels of the national security structure. An atmosphere of intellectual freedom and open discussion is encouraged.

The course is action-oriented. It blends formal lectures and small group activities, and encourages individual development through independent reading, study, and writing in areas of particular interest to the student.

The resident course has grown and changed in response to the evolving and increasingly complex pattern of national security. The program now consists of six basic "core" courses which provide a survey of the major facets of national security and resource management. Three semester-length "foundation" courses covering the fields of economics, quantitative analysis, and organization and management support the core curriculum. In addition, electives are offered in various areas related to students'

Lieutenant General John S. Hardy, USAF, is Commandant, Industrial College of the Armed Forces. Previously, he was Commander, Allied Air Forces, Southern Europe. He is a graduate of Centenary College, the Air War College and the National War College.

career objectives. Optional courses may be taken. Rounding out the resident program are: industrial and international field trips; student research projects; simulation exercises; case studies of historical, problem-solving, and decision-making varieties; panel and group discussions and committee analysis; and a lecture program that features nationally prominent authorities.

Until 1947 the ICAF educational program was confined to the resident course. It became evident, however, that extension programs would be needed in order to reach the many thousands of high-level officers and civilian officials who could not attend in residence. In January 1948, in New Orleans, ICAF introduced a program of 2-week seminars for reserve officers. Within a few years, in response to local initiative, the program was made available to representatives of local business, academic, and civic groups. The Seminar School presents these seminars in selected communities under local sponsorship. Led by officers from the military components of the college faculty, the seminars give the conferees a better appreciation of the basic developments and problems in the management of our national security affairs.

An increasing demand for further extensions of the college program resulted in establishment in 1950 of a graduate-level correspondence course. This course has evolved as an off-post version of the resident course, and has undergone much the same broadening of scope and changes in emphasis over the years. The August 1966 issue of the *Defense Industry Bulletin* carried an article by Major General William S. Steele, former Deputy Commandant of the Industrial College of the Armed Forces, entitled "The New Look of Our Correspondence School." In this article, General Steele pointed out that the school had just started a major adjustment of its curriculum to reflect the new directions and emphasis of the resident course. The changeover has now been substantially accomplished, and many new developments have taken place or are in the offing.

Correspondence Study Programs

Until mid-1967, the Correspondence School offered one course of study entitled "National Security Management." In July 1967, the school embarked on a second, shorter course, "Management in the Department of Defense," which is extracted from the basic National Security Management course. At the same time, the school introduced a Selective Study Program, in which individual texts and monographs from the National Security Management course may be used for information in a specific subject area. Through the two formal courses and the Selective Study Program, the school affords greater flexibility to prospective students in their studies of areas most appropriate to their needs or interest.

National Security Management.

National Security Management is the Correspondence School's basic course of instruction. It contains study material covering the fundamental aspects of areas of knowledge that are essential to effective management of national security. National Security Management is adapted from the subject matter of the resident curriculum to the correspondence method of study. The subject matter is selected and organized to provide a basic understanding of a wide area and to avoid minor details and useless generalities. It is not designed to train specialists in any particular field but, rather, as the ICAF charter directs, to impart knowledge and understanding of the economic and industrial aspects of national security, and of the management of resources in all conditions and in the context of both national and world affairs.

The course material is presented in small bound volumes, and is organized into five integrated units of study:

- **Unit I, Foundations.** This unit presents a look at the role of the United States in concert with other nations, in the world community, and the top-level direction and management of our national security affairs. In addition, it provides an orientation in the elements of basic economics and of economic analysis, and in the concepts and practices of modern management.
- **Unit II, The Resources Base for National Security.** This unit appraises our available resources for achieving security. These economic capabilities and significant potentials include human, natural, and energy resources; science and technology; transportation; and three important utilities (electric power, natural gas, and telecommunications). A final volume in this unit, **The Industrial Sector**, reviews the evolution, major characteristics; structure, magnitude, and growth trends of the American industrial economy; and the role of production with its interlocking relationship to other elements of the economy, and its importance to the nation's strength and well-being.
- **Unit III, Plans and Programs for National Readiness.** This unit presents information relating to certain basic national policies which provide the framework within which national security is managed. Subjects include programs and policies to maintain the strength, stability, and dynamism of the national economy as the essential base for the nation's security; U.S. foreign economic policy; U.S. collective defense and foreign assistance programs; the methods and current planning for economic stabilization under various conditions of emergency; and the nature and scope of the problems anticipated in the event of a nuclear attack on the homefront and the preparedness measures that are being taken to deal with these problems.
- **Unit IV, Defense Plans, Policies, and Decisionmaking.** This unit introduces the student to the concepts, principles, and policies which underlie and give direction to the managerial effort in the Defense Department. Areas receiving primary attention include Defense organization, planning, programming, budgeting, and systems analysis.
- **Unit V, The Management of Defense Programs.** This unit deals with management in specific functional areas within the Defense Department: research and development, procurement, production, and supply management.

To help keep pace with ever-changing concepts and new developments, particularly in DOD's broad areas of interest, the 24 textbooks that now comprise the National Security Management course are supplemented by a series of monographs, chapter-length surveys dealing with specific national security and defense management problems. All break new ground. The substance of some monographs will find their place in the periodic revision and updating of existing texts; other monographs will form the basis for new, full texts in select defense management areas.

Since the beginning of the monograph program in 1967, the following monographs have been published:

Defense Resource Management Systems: Project PRIME
Production Management: The Defense Materials Systems
International Logistics: Interallied Collaboration in Weapons Production
International Logistics: Foreign Military Sales
Defense Manpower: The Management of Military Conscription
Defense Manpower: Management of the Reserve Components
Defense Transportation: The Military Traffic Management and Terminal Service
Maintenance Management in the Department of Defense
Management of Defense Intelligence
Defense Weapon Systems Management
Defense Planning and Budgeting: The Issue of Centralized Control

At present, monographs are being developed on resource management in conditions of limited war, integrated logistic support, systems analysis and the political process, and the role of DOD in civil disturbances. The monograph series is important as a means of dealing with the problem of textbook obsolescence and of adding to the freshness and vigor of the instructional programs.

Correspondence School students as well as graduates now receive the ICAF journal, *Perspectives in Defense Management.* Each issue of *Perspectives* contains a representative selection of current Resident School auditorium presentations, student research reports, and other materials drawn from the educational programs of the college. From time to time, as the situation warrants, students receive additional materials, such as the abridgments of the posture statements of the Secretary of Defense which appeared in recent issues of the *Defense Industry Bulletin.*

Management in the Department of Defense.

This course is based on 11 text books from the comprehensive National Security Management study program, supplemented by monographs focusing on defense management. There are two integrated units of study:

- **Unit I, The Environment of Defense Management,** contains two elements. The first, Orientation: The Underlying Disciplines, presents the broad managerial and economic concepts which form the interdisciplinary approach to management in DOD. The second element, Defense Plans, Policies, and Decisionmaking, introduces the student to the concepts, principles, and policies that underlie and give direction to the managerial effort in DOD. Areas given primary attention include: defense organization, planning, programming, budgeting, and systems analysis.
- **Unit II, The Management of Defense Programs,** deals with management in specific and related functional areas within the Defense Department's missions: research and development, procurement, production, and supply management.

As in the case of the National Security Management course, supplementary monographs and other materials introduce the student to additional functional areas of defense management and to new and particularly significant developments in this field.

Selective Study Program.

The Selective Study Program is available to a limited group of officers and civilian officials who have need for information within specialized areas. This is not a formal course of study. Individual textbooks and monographs are selected from the basic National Security Management course.

The Bluebooks

The success of the three study programs depends in large measure on the quality and timeliness of the Correspondence School's educational materials. In this respect, the school's specifically tailored textbooks—popularly referred to as "bluebooks"—have been of paramount importance. Plans for curriculum development are prepared, reviewed and revised each year on the basis of a 3-year textbook development and revision cycle. The objective is to achieve the maximum practicable correlation with resident instruction and to reflect the ever-changing perspectives, concepts, and problems in defense and national security management.

A small textbook development group within the Correspondence School devotes much of its time and effort to this task. In collaboration with other members of the Industrial College faculty and with the assistance of outside experts and selected resident students, the group has been through two full cycles of textbook development and revision since its activation early in 1961. Drafts of new and revised textbooks and monographs are coordinated with the college's Academic Plans and Research Office and the Resident and Seminar Schools. These and other components of the college have helped the Correspondence School to ensure that its instructional materials are sufficiently comprehensive to achieve educational objectives; are accurate and reflect current knowledge and practice; are prepared by professionally qualified personnel; are organized and presented in accordance with sound psychological principles of learning; and are attractive in layout and format.

The following textbooks are now in use:

The Environment of National Security
The National Security Structure
Elements of Defense Economics
Management: Concepts and Practice
Human Resources for National Strength
Natural and Energy Resources
Transportation: The Nation's Lifelines
Utilities: Electric Power, Natural Gas, and Telecommunications
Science and Technology: Vital National Assets
The Industrial Sector
Economic Policies for National Strength: The Quest for Sustained Growth and Stability
United States Foreign Economic Policy
Emergency Economic Stabilization
Civil Defense: Planning for Survival and Recovery
Collective Defense and Foreign Assistance
Defense Organization and Management
A Modern Design for Defense Decision: A McNamara-Hitch-Enthoven Anthology
Case Studies in Military Systems Analysis
A Commentary on Defense Management
Requirements: Matching Needs with Resources
Defense Research and Development
Procurement
Production for Defense
Supply Management

Of these 24 texts, only 3 bear publication dates going back to 1964. Two were published in 1965, 5 in 1966, 6 in 1967, and 8 in 1968. Work is in process to update the few oldest texts. All in all, considering the long lead times from conception to production and publication of textbooks, the Industrial College can take rightful pride in the currency, as well as in the high quality, of its bluebooks.

Although they are designed basically for its instructional needs, the Correspondence School's textbooks are used extensively in other ICAF programs and in the programs of other government agencies. All Services, for example, draw heavily on the bluebooks in support of their ROTC programs. The Business and Defense Services Administration of the Commerce Department recently ordered 3,000 copies of the ICAF text, "Production for Defense," for use by agency headquarters and field staffs, and for the orientation and training of BDSA's National Defense Executive Reservists.

Forward Planning

Along with other components of the Industrial College, the Correspondence School has been projecting its plans and programs on a 5-year basis, which helps to ensure an orderly identification of education requirements and permits suitable planning for the best use of resources. The school is guided by college-wide assumptions about the future world, domestic and defense environments, the clientele to be served, and basic educational goals. Within this frame of reference, the school plans its operations so as to improve on-going programs and to meet projected educational objectives over a reasonable period.

To date, much of the Correspondence School's effort has been directed to the conduct and support of individual home study under the National Security Management and Management in the Department of Defense courses. In the past year the school began to expand a concept in educational methodology—one that combines the advantages of guided self-study with those of group discussion. This group study program places emphasis on individual preparation and study as a prelude to group discussion. At the group meetings each member presents his opinions and reactions, and compares his experience and thinking with those of other members. This provides a strong motivation to the individual participants and helps to develop and project intellectual and leadership capabilities. Enrollments in group study now total approximately 4,000 (2,000 Army, 500 Navy and Marine Corps, and 1,500 Air Force).

Group study programs have been organized for the most part in local reserve officer training schools and units. The Military Services provide facilities and instructors; ICAF enrolls each student individually, provides text materials, tests, evaluating and counseling services, and assists in the development of instructors' guides.

In addition, a number of study groups, containing a mixture of reservists, regular officers, and civilians, have been organized, mainly in the Washington area. On occasion, ICAF faculty have served as visiting instructors for these local groups. We contemplate expanding this program, with increasing ICAF participation and, if experience indicates the desirability of such action, with ICAF leadership of some groups.

Looking further into the future, ICAF may conduct or sponsor an Associate Correspondence Course, using the group-study approach and aimed primarily at active duty military and government civilian officials at major headquarters and bases of military and other government departments, to whom reserve officer group-study is inaccessible or inconvenient. If considered to be desirable and practicable, this program will be extended progressively, with ICAF playing a large role in providing study materials, guidance, instruction, monitoring, and inspection.

Still further in the future is the concept of a Senior Associate Correspondence Course. Conducted by ICAF, that course would be aimed primarily at senior active-duty and reserve officers and government executives in the Washington, D.C. area, who are not able to attend the resident course. Based on the National Security Management and Management in the Department of Defense course materials, this course would be supplemented extensively by study materials drawn from the resident program. It may include limited attendance at Resident School lectures, and could well develop ultimately into an "associate" resident program.

Also in the concept stage is an advanced course on defense decision making. This is visualized as a home-study program for graduates of the resident or correspondence courses. Rigorous educational qualifications for admission would be established, and the course would be based on specially developed materials focused on sophisticated aspects of defense decision making. The course requirements would be demanding, and students would have wide latitude for individual specialization.

The move toward group study has created a need for comprehensive guidance for instructors in the effective conduct of discussions. The Correspondence School is cooperating with the Military Services in the design of instructors' guides for use in reserve officer group study programs. ICAF may ultimately assume full responsibility for the design of instruction guides for all existing, new, and revised texts, as well as for the preparation of course outlines, summaries, interpretative commentaries, and other materials. These would help individual students, as well as group leaders, to get the greatest benefits from Correspondence School programs.

The Correspondence School will strive for continuing improvement of curriculum materials, educational methodology, and evaluation techniques in both its home and group-study programs. It is continually developing and systematically refining course materials, and is making meaningful estimates of student comprehension and achievement. Multiple choice examinations have been constructed to measure learning effectiveness in terms of clearly defined educational objectives. The school follows a constructive program to encourage students to start, continue and finish the courses in which they have been enrolled, and professional counseling reinforces learning.

Considerable effort is now going into design, testing and validation of test items, analysis of results, and standardization of examinations.

An Opportunity for Self-Development

Considering the importance of the issues involved in our national security and the proportion of resources devoted to its support, education of present and future policymakers and leaders in this field cannot be passed over lightly. For those who cannot attend the resident course, the Correspondence School's programs offer extraordinary opportunities to develop the professional attitudes, perspectives, and breadth of view needed for leadership in today's defense environment. The school's objective is *education, not training.* Specialists, as well as generalists, will profit immeasurably from close, disciplined study of the texts and other educational materials used in the Correspondence School's two formal courses of instruction. Successful completion of these courses requires diligent application of time and effort: an average of 12–15 months for the National Security Management course; and some 4–6 months for the shorter, derivative

Management in the Department of Defense course.

Enrollment in ICAF Correspondence School programs requires a college education through the baccalaureate level or its equivalent in professional experience. Specifically, the National Security Management and Management in the Department of Defense courses are open to:

> **Military officers of all components of the Defense Department and the Coast Guard who are serving on active duty.**
>
> **Military officers of all components of the Defense Department and the Coast Guard who are on inactive duty in the grade of major or lieutenant commander and above. Also, officers of junior grades who are affiliated with an organized reserve program or reserve officers' school may be enrolled.**
>
> **Federal, state, or local government employees rated GS–11 (or equivalent) and above will be accepted, and trainees in civil service intern programs with lower ratings may be accepted if they are recommended by appropriate supervisors.**
>
> **Civilian executives and members of the several professions may be accepted if ICAF resources permit.**

All applicants are considered on their individual merits. In some instances, applicants who do not fully satisfy the specified selection criteria may be accepted on a conditional basis, and participation on this basis will be continued as long as the student demonstrates satisfactory progress.

The selective study program is open to military officers of all components of DOD serving on active duty in the grade of lieutenant colonel or commander, and above, and to Federal employees rated GS–13 and above.

Course materials are provided at no cost to the student. Each student who successfully completes a study program is permitted to retain the texts and the supporting monographs and related materials for his personal library. In most instances, the texts will remain on the graduate's bookshelf within easy reach for re-reading and reference.

A certificate of completion signed by the Commandant of the college is issued to everyone who satisfactorily completes either the National Security Management program or Management in the Department of Defense program. Distinguished graduates in either course receive special letters of recognition. Satisfactory completion of the courses by military officers and civilian government employees is officially reported to the appropriate Military Service or civilian agency.

Reserve officers not on extended active duty may earn 60 reserve points through successful participation in the National Security Management study program. These officers may earn 24 reserve points through successful participation in the Management in the Department of Defense program. Reserve points have not been authorized for the selective study program.

Over and above the special incentives of reserve points, certificates of completion, and the opportunity to acquire a unique collection of books, there is the satisfaction of having undergone a rich educational experience. The Correspondence School's programs go far to broaden the student's horizons and sharpen his professionalism. The graduate's reward will lie in the knowledge that, through this extra effort, he is better equipped for service in the national and international security structure. In this respect the ICAF Correspondence School is not just one more instrument for continuing education; it is a vital component of the nation's preparedness for leadership in emergencies.

U.S. Army Test and Evaluation Command

(Continued from Page 5)

oping, producing, supplying and maintaining the Army materiel scheduled to be in the pipeline at that time.

TECOM is plugged into the main logistics circuit. It is part and parcel of the total system. At the very least, the command's test reports and recommendations provide the reliable basic data needed for evaluating Army materiel at any stage in its life cycle —from concept to discard.

Already rich in experience, the seven-year-old Test and Evaluation Command represents the Army's first long step in the direction of an ideal test organization. Its further development as the principal decision-making tool in the Army's new logistics system is limited only by its capability to absorb and exploit tomorrow's technology, management processes, methodology, instrumentation and engineering concepts.

In short, when our legions are sent to the stars, TECOM will be ready. It has already tested vehicles for use on the surface of the moon!

Electronics Aid Photomapping for Air Force

A new electronic aid to airborne geodetic surveying, the Refractive Index Sounding System (RISS), is being developed for the Air Force.

The system is being produced by the Bendix Environmental Sciences Division, Towson, Md., under the direction of Aerospace Instrumentation Program Office of the Air Force Systems Command's Electronic Systems Division, L.G. Hanscom Field, Mass.

RISS will be used to gather meteorological data, such as temperature, pressure and humidity, for computation of the atmospheric refractive index. This, in turn, will permit correction of radio signal tracking errors caused by water vapor in the atmosphere. The corrections result in increased accuracy of longitude and latitude determination on photographic maps.

The RISS program calls for 10 portable sounding systems, to be completed in 1970. Each unit includes an antenna, baseline calibration chamber, gasoline generator and balloon radiosonde.

Eventually, RISS will be used in the Aerospace Cartographic and Geodetic Service's photomapping mission to conduct world-wide photomapping surveys.

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(Continued from Page 18)

Determination of Polyhydric Alcohols in Alkyd Resin by Gas Liquid Chromatography. U.S. Army Coating and Chemical Laboratory, Aberdeen Proving Ground, Md., March 1969, 19 p. Order No. AD-685 821.

Isolation of Solvents from Organic Coatings by Air-Flush Vacuum Distillation Technique. U.S. Army Coating and Chemical Laboratory, Aberdeen Proving Ground, Md., March 1969, 14 p. Order No. AD-685 822.

Fungus-Inhibitive Coatings in a Jungle Environment. Naval Research Laboratory, Washington, D.C., Feb. 1969, 16 p. Order No. AD-684 764.

ASPR Committee Case Listing

The following is a listing (revised as of June 9, 1969) of the cases currently under consideration by the Armed Services Procurement Regulation (ASPR) Committee, of the Office of the Assistant Secretary of Defense (Installations and Logistics).

On items marked by asterisks, the text has been omitted to shorten the listing. The asterisks denote actions taken as shown below:

**—Case closed, no ASPR revisions resulting.*

***—Case closed, approved for printing in a subsequent ASPR revision.*

****—Case closed, approved for printing subject to further government coordination.*

The listing includes subjects of interest to contractors but excludes cases of a minor or editorial nature, those considered sensitive, and those involving a deviation from the regulation which are processed by the ASPR Committee.

The ASPR Committee meets with representatives of major industry associations periodically to explain the purpose and status of each of the cases under consideration, and to answer questions from industry representatives concerning the cases. All proposed ASPR changes of major policy are forwarded to industry associations in draft form for the review and comments of the association memberships. Industry comments are evaluated by the Defense Department before a final decision on the proposal is made by the ASPR Committee.

***Rental Charges for Use of Government Property.**

****Cost Principle—Depreciation.**

****Equal Employment Opportunity.**

Review of the Implementation of Public Law 87–653. To undertake a review of the ASPR implementation of Public Law 87–653 on the basis of the experience thus far obtained, to determine the need for further guidance or clarification of such coverage. This review has been divided into five broad areas as follows:

(a) **The submission of data.** When is data submitted? Submission vs. disclosure or availability. Identification of data. Contracting officer (and other) documentation.

(b) **Definitions of "current" and "complete."** From the standpoint of reasonableness and practicability. How should significance be considered?

(c) **Examination of Records.** Audit before negotiation. Audit after contract award. Audit of subcontractor data.

(d) **Subcontract Problems.** Subcontracts under firm fixed-price primes. Second- and third-tier subcontracts.

(e) **Significance.** From the standpoint of price negotiation vs. application of defective pricing clause. Price changes after price agreement but before contract award.

Proposed coverage on (a), (b), (c) and (e) was previously circulated to industry for comment, and the results of this effort were issued in Defense Procurement Circular No. 57, dated Nov. 30, 1967.

Proposed coverage on the subcontract aspect of this matter has been forwarded to industry and other government agencies for comment. The comments have been received and consideration of this aspect of the problem is continuing.

Cost Information Reports (CIR). Proposed ASPR coverage for Cost Information Reports has been developed and was approved for print by the ASPR Committee. However, printing has been withheld because the basic **DOD** instruction is being revised and the changes contemplated will require redrafting the ASPR coverage. A CIR clause was issued in ASPR Revision No. 30, dated Sept. 1, 1968. Revision of the instruction is still in process.

*****Contract Modifications.**

***Handbook for Procurement Quality Assurance.**

Communications Services. Development of uniform ASPR coverage which would permit deletion of existing departmental coverage with respect to procurement of communication services from both regulated and unregulated suppliers. Industry comments have been received, considered and revised coverage developed. Final action on this coverage has been delayed awaiting review by higher authority.

Advance Understandings of Allowability, ASPR 15–107. To revise the existing ASPR paragraph to explicitly provide that such agreements must be in writing to be binding on the Government. Proposed ASPR coverage concerning Advance Understandings on Particular Cost Items was forwarded to industry for comment on May 29, 1968. The subject matter, together with comments received from industry and other government agencies, are still under consideration.

***Compensation Review Procedures.**

****Help Wanted Advertising—ASPR 15–205.33.**

Technical Data Warranty. To consider the advisability of incorporating in ASPR a warranty clause for technical data. Proposed ASPR coverage with respect to the subject matter was forwarded to industry for comment on May 17, 1968. Industry comments have been received and considered, and the proposed ASPR coverage developed under the subject matter has been approved for printing subject to ratification by higher authority.

****Predetermination of Rights in Data.**

***Reporting of Labor Disputes.**

***Modification of Weighted Guidelines To Give Greater Recognition to Invested Capital.**

****Purchase vs. Lease; Allowability of Costs under ASPR 15–205.34 and 15–205.48 for ADPE, Other Equipment and Buildings.**

Revisions to ASPR 15–205, Cost Principles on Bid and Proposal and Independent Research and Development. The proposed revisions to the existing ASPR cost principles on Independent Research and Development and Bid and Proposals were developed as a staff action outside of the ASPR Committee, and referred to the committee for editing and obtaining of industry comments. This material was forwarded to industry on Jan. 29, 1968. On March 25, 1968, the reporting date for submission of comments by industry and government agencies was extended to June 30, 1968. Industry comments have been received and are under study.

****Revision to ASPR 15–205.41—Taxes.**

****Evaluation of Options.**

****Limited Rights Legend.**

Clauses for Service Contracts. To develop a new part for ASPR Section VII to cover service contracts generally, incorporating by reference to the extent feasible the fixed-price and cost-reimbursement clauses contained in Parts 1 and 2 of Section VII. This matter is still under development.

****Organization Costs, ASPR 15–205.23.**

First Article Approval. To consider revising the First Article Approval policy set forth in Section I, Part 19, in light of the difficulties which have been experienced both by the Government and by industry under the existing ASPR coverage. Consideration of a proposed revision of the subject matter began in June.

Revision of the CWAS Coverage. To consider recommendations submitted by the Industry Advisory Council Working Group to lower the threshold and also extend the CWAS coverage to certain areas of administrative controls now excluded from the CWAS coverage. Consideration of this matter began in June.

Proposed ASPR 9–203(f) Clause, Rights in Technical Data—For RDT&E and Acquisition Contracts for Major Systems and Subsystems. To consider modifying the ASPR policy, concerning rights in technical data, insofar as RDT&E and Acquisition Contracts for Major Systems and Subsystems are concerned, by prescribing a special cause for inclusion in prime major systems and prime subsystems RDT&E contracts which would require the contractor to permit subcontractors to sell subcontractor fabricated parts or services directly to the Government without the payment of license fees or other inhibition notwithstanding that such subcontractor effort may require the use of limited rights data furnished by the prime contractor. Consideration of the coverage in this area was delayed awaiting receipt of comments from CODSIA. The comments, dated April 28, 1969, are now under study.

Mandatory Application of ASPR Cost Prin-

ciples in Fixed-Price Contracts. To develop a revision of ASPR Section XV to make use of the cost principles set forth in Parts 2, 3 and 4 mandatory in fixed-price contracts, whenever costs are relevant in the pricing of fixed-price contracts. A draft of the proposed coverage to accomplish the foregoing was forwarded to industry for comment on May 14, 1969.

****Aircraft, Missile, Space Vehicle Accident Reporting and Investigation Clause.**

Title and Risk of Loss Clause—7–103.6, Applicability to Cost Reimbursement Type Contracts. To consider the applicability of the Title and Risk of Loss Clause, ASPR 7–103.6, to cost-reimbursement type contracts, in light of a letter from AIA, dated April 9, 1969. This problem is under consideration by the committee.

Definitization Clause for Letter Contracts. Industry comments on the proposed clause have been received. This matter is currently under consideration.

***Contributions and Donations.**

ASPR 14–406, Nonconforming Supplies and Services. Revise ASPR 14–406 covering Acceptance of "Nonconforming Supplies or Services" to emphasize government policy that supplies or services which do not conform in all respects to the contract requirements be rejected; and to simplify the administrative burden created by the acceptance of nonconforming supplies and services. This matter was forwarded to industry for comment on May 1, 1969.

Amendment of Certain ASPR Provisions Relating to Patents and Data. To update and correct ASPR Section IX dealing directly or indirectly with respect to Patents and Technical Data provisions without making any substantive change in the section, as well as providing a new assignment form for use in lieu of the form presently appearing is ASPR 9–109.4. This material was forwarded to industry for comment on April 10, 1969.

Delinquent Delivery Schedules on Other Than Cost-Reimbursement Type Supply and Service Contracts. To modify various provisions of Section VIII, Part 6, to clarify the rights and obligations of both parties in the event of delinquent performance. The proposed revisions were forwarded to industry for comment on March 3, 1969.

Review of Bid Protest Regulations. To consider the recommendations of the Senate Select Small Business Subcommittee with respect to the subject matter in coordination with the General Services Administration (GSA). Changes to the ASPR and FPR coverage in the subject area have been developed and are currently being considered by higher authority in DOD and GSA. Upon ratification, these changes will be issued in subsequent revisions to the two regulations. It is not contemplated that industry comments will be solicited in this area.

Proposed Revision to ASPR 15–203 Regarding Off-Site Burden Rates. To revise 15–203(d) to emphasize the possible requirement for special overhead rates for contracts performed at locations physically removed from the contractor's primary location. The proposed revision in this area was forwarded to industry for comment on March 3, 1969. Comments have been received and are currently under consideration.

Application of Burden to Settlement Expenses and Settlements with Subcontractors. Proposed revisions to ASPR Section XV, 15–205.42(f) and (g) to clarify the treatment of settlement expenses taken into account following termination were forwarded to industry for comment Feb. 6, 1969. Industry comments have been received and are currently under consideration.

Accounting and Control for Government-Owned Property. This case, which addresses itself to the responsibility for loss or damage to government property occurring during the period when an acceptable property system was not maintained, has been circulated to industry for comment. These comments are presently being evaluated by a subcommittee before further review by the Contract Administration Panel and the ASPR Committee.

Transfer of Materials Between Contracts. This case addresses itself to a proposal to permit easier transfer of material between contracts, and to permit retention by contractors of excess, contractor-acquired, government-owned material at the lesser of cost or market, and was submitted to industry for comment on Feb. 13, 1969. Comments have been received and are being considered.

CODSIA Termination Recommendations. This case contains requirements for the contracting officer to notify the contractor under a partially funded cost-reimbursement type contract to submit a proposal for the adjustment of fee when the contractor is approaching the limits of the funds allotted to the contract, and the contract is not to be further funded. Other miscellaneous changes in Section VIII are also included. The case was submitted to industry for comment on Feb. 27, 1969. Comments have been received and are being considered.

"Terminations - Deferring Determination Whether for Default or Convenience" Clause. To consider whether an ASPR clause embodying the subject concept should be developed for inclusion in the regulation. Such a clause, halfway between the present ASPR "Default" clause and the present ASPR "Termination for Convenience of the Government" clause, would permit termination of a contract while deferring the contracting office's decision as to whether (1) the contract is in default or (2) termination should be for convenience of the Government. To also consider whether the "Stop Work Order" clause should be modified to authorize conversion of a stop work order to a termination for default as well as a termination for convenience, as is now provided.

Guidelines for Administration of Small Business/Labor Surplus Area Subcontracting Program Clauses. To develop uniform guidelines for administration of the Small Business/Labor Surplus Area Program clauses at both the prime and subcontract level. The ASPR coverage upon adoption would supplant the similar though not identical coverage currently used by the Military Departments.

Foreign Tax Clause, 11–403. To consider whether the Foreign Tax clause, prescribed by 11–403, should be revised in light of the letter received from CODSIA, dated Dec. 20, 1968, recommending adoption of a revised foreign tax clause.

Conflict of Interest Clause. To consider whether further guidance in the regulation and appropriate contractual safeguards should be provided to avoid conflicts of interest which may be occasioned by acquisitions and mergers involving systems engineering contracts.

ASPR Section IX, Part 2. To consider whether amendments to Section IX, Part 2, and other pertinent ASPR sections are necessary in view of the re-issued DOD Instruction 5010.12, dated Dec. 5, 1968, entitled, "Management of Technical Data."

Use of Firm Fixed-Price Contracts for Development. To consider whether the ASPR coverage concerning use of firm fixed-price contracts for development should be revised in the light of studies made by the Military Departments in addition to prior changes made in the ASPR Revision No. 30.

Construction Warranty Clause, ASPR 1–324. 10. To develop a revision of the subject clause in light of comments of the Association of General Contractors covering (1) design, (2) damages from defects and failures, and (3) use of the term "agent."

Specially Rated DOD Insurance Plans; (A) DOD Term Insurance Plan and (B) The National Defense Project Rating Plan. To review the cited insurance plans to ascertain whether revisions thereof are necessary in order for them to accomplish their intended purposes, particularly in the light of the fact that the plans are not being used to the optimum extent.

Recommended Changes to (A) Group Insurance Plans Under Cost-Reimbursement Type Contracts, 10–505, and (B) "Insurance-Liability to Third Persons" Clause, 7–203.22. To consider a revision of (1) 10–505 "Group Insurance Plans Under Cost-Reimbursement Type Contract" to provide for review by insurance personnel of the Military Departments, rather than approval and submission of the insurance representative's findings to the Defense Contract Audit Agency as to the allowability of costs of such plans; and (2) 7–203.22 "Insurance-Third Party Liability" clause to make mandatory the submission of group insurance plans under the clause to the Government for review.

Location Allowances at Unfavorable Locations. To consider whether the desirability of removing the current language in 12–105 and 15–205.6(j) on the basis that the existing coverage is no longer necessary, does not serve a useful purpose and, thus, should be eliminated. In conjunction with this action, to consider the desirability of modifying 15–107(i) to add coverage with respect to allowances for off-site pay, incentive pay, location allowances, hardship pay, cost of living differential, and the like.

Verification of Catalog or Market Price Exceptions Under Public Law 87–653. To consider the recommendation of the General Accounting Office that ASPR be revised (1) to require contractors to submit sales data of recent commercial sales for approximately similar quantities of the proposed purchase by the Government, prior to acceptance by the Government of a catalog or market price; and (2) to further provide that contracting officers be required to verify the sales data submitted by contractors.

Health and Safety Clauses. To review and present recommended changes concerning the applicability of the Health and Safety clauses currently prescribed in 7–104.78, .79 and .80, in light of the comments on this matter received from CODSIA.

Government Property Clauses. To consider the desirability of revising the Government Property clauses to require contractors to assume responsibility for low dollar amount repairs to government furnished property, thus paralleling the procedure currently used in the Ground and Flight Risk clause which eliminates the administrative burden resulting from low dollar value claims under the Ground and Flight Risk clause.

Revision of ASPR B–311, C–311 and S3–603. To make necessary revisions to Appendices B–311 and C–311 and Supplement 3 to provide for uniform reporting by contractors on gov-

(Continued on Page 36)

Air Force Flight Dynamics Laboratory—Focal Point for Most Flight Vehicle System Technology

Colonel Joseph R. Myers, USAF

The Air Force Flight Dynamics Laboratory—Where is it? What is its mission? What is it? What does it do, and what is portended for its future? The Air Force Flight Dynamics Laboratory (AFFDL), located at Wright-Patterson AFB, Ohio, is one of the nine laboratories of the Air Force Systems Command (AFSC). In consonance with its mission, it is the focal point in the Air Force for all technology associated with flight vehicle systems, except for the propulsion and avionics subsystems. The broad flight vehicle technical domains for which the laboratory has responsibility are:

- Structures.
- Flight mechanics (aerodynamics, aerothermodynamics, performance and trajectory analysis).
- Dynamics (vibration, flutter and acoustics).
- Flight control (stability and control, handling qualities, cockpit displays, components and subsystems).
- Vehicle equipment (internal environmental control, retardation and recovery, crew escape and crew stations, airframe bearings and landing gear subsystems).

The program of the laboratory (both in-house and contracted) contains the Air Force exploratory and advanced development effort associated with the forementioned technical domains.

Basic objectives to which the laboratory addresses its effort are, first, to conduct an exploratory and advanced development program which is directed toward the solution of critical technical problems anticipated in the development of future Air Force flight vehicles; second, in the laboratory's areas of responsibility, to continually enlarge and upgrade techniques, design criteria, ground and flight simulation methods and instrumentation which can be used as a technological foundation for the design of advanced flight vehicles, possibly not yet even in the concept stage; and, third, to provide quick response solutions to Air Force problems associated with operational flight vehicles, particularly those involved in Southeast Asia and with flight vehicles under development.

In fulfilling these objectives and responsibilities, the laboratory must conduct unceasing review and assessment of the possible enemy threats and current and future needs, as expressed in research and development guidance sources, to ensure that its program is responsive. This function has a further payoff in that, when industry responds to Requests for Proposal on contracted portions of the laboratory's research and development program, it can do so with the knowledge that these programs reflect future Air Force requirements. This knowledge enables industry to better plan its own internal flight vehicle technology research and development programs, using Air Force guidance toward areas of future interest.

Further coupling with industry is provided through laboratory review of the work being accomplished under independent research and development programs of the major airframe manufacturers. The laboratory is charged by DOD with this responsibility in the areas of flight vehicle technology. Exchanges of viewpoints on needs and the work being conducted and planned are intended to lead toward more significant efforts and findings. The laboratory, also, constantly assesses the effort of flight dynamics research and development being conducted in other Service laboratories, the National Aeronautics and Space Administration (NASA), the Federal Aviation Agency, and industry. This assessment ensures knowledge of the current relevant state of the art and assures more effective direction of efforts, particularly important in view of limited budgets.

A viable interface with the technical and scientific community, and an awareness of military and national goals and changing bases of technology, is maintained through participation by laboratory personnel in a wide range of organizational activities. They serve on planning and working units of inter-Service, national and international groups. AFFDL personnel are assigned to committees and special groups of DOD, the Defense Atomic Support Agency, Headquarters, U.S. Air Force, NASA, NATO's Advisory Group for Aerospace Research and Development, the American Institute of Astronautics and Aeronautics, and American Standards Association, the National Academy of Sciences, and a large number of technical and scientific societies.

In ferreting out Air Force current and future technical needs in the various areas of flight dynamics, AFFDL uses several techniques. To obtain data and define problems in-

Colonel Joseph R. Myers, USAF, is Director of the Air Force Flight Dynamics Laboratory. In prior assignments, he was Commander, 6511th Test Group (Parachute), and Test Force Director, X–20 Dyna Soar. Colonel Myers is a graduate of Purdue University and holds a masters degree in aeronautical engineering from the Massachusetts Institute of Technology.

volving capabilities of flight vehicles in the Southeast Asia conflict, teams of specialists have been sent to the area for on-the-spot determinations. For example, a comprehensive aircraft survivability program for conventional weapon threats was developed from such initial surveys. A common method for determining needs has been working level, eyeball-to-eyeball discussions with personnel from the Air Force's operational commands and AFSC's product divisions (Aeronautical Systems Division, Electronic Systems Division, and the Space and Missile Systems Organization). To ensure that the laboratory program is properly responsive, AFFDL personnel review documented technical needs from the product divisions for program guidance.

Diversity of Technical Effort

Some of the technical concepts which the laboratory has recently explored and advanced in response to Air Force needs are:

- Self-contained aircraft oxygen systems.
- Steerable parachutes.
- Beryllium structural members.
- Development of XV–4B aircraft for VTOL flight control research.
- Expandable aircraft tires.
- Air cushion landing gear.
- Portable low visibility approach and landing equipment.
- Survivable flight control system (fly-by-wire).
- Dynamic vehicle loads determination for substandard landing sites.
- High lift-to-drag reentry vehicle configurations.
- Improved vehicle trajectory analysis techniques.
- High temperature structure incorporating cryogenic tankage.

A few of these will be described briefly to indicate the scope and status of the efforts. Some of the concepts have been developed to the point of incorporation into flight vehicles. AFFDL efforts are bringing many of them into consideration in the design and development cycle of a number of vehicles.

A new on-board oxygen supply system, which concentrates oxygen from the air, is in final development for use in fighter aircraft. Feasibility has been established for this unique device in which a highly reliable static electrolytic cell produces 100-percent pure breathing oxygen. Successful development of the oxygen concentrator will revolutionize breathing oxygen logistics by eliminating the need for the present extensive ground support facilities and equipment associated with liquid oxygen manufacture, storage, transportation and servicing.

The laboratory has developed prototype automatic homing parachute systems for precise delivery of urgently needed supplies and equipment. A steerable radio-homing system has been flight demonstrated to the Tactical Air Command. Inherent in this concept is the almost limitless size of the parachute payload, which may be small emergency supply packages or heavy earthmoving equipment, trucks, artillery, nose cones, or satellites. The steerable parachute is potentially important for applications ranging from situations such as the Vietnam war to space program endeavors.

Initial use of beryllium as a primary load-carrying aircraft member was a joint effort of AFFDL and McDonnell-Douglas Corp. to design, build and flight test a beryllium rudder on an F–4 aircraft. This rudder is 35 percent lighter than the production F–4 rudder and four times as stiff. While the use of beryllium in the F–4 rudder is not a "cost effective" application, this program has demonstrated that beryllium design technology for aircraft use is "here." As a result, beryllium can be considered in future systems where its outstanding strength/weight ratio can justify its cost.

AFFDL has complete technical and management responsibility for developing flight control system criteria and techniques for vertical takeoff and landing (VTOL) aircraft. The VTOL program, the only one of its type underway in this country, involves the design, development and test of the XV–4B jet-lift vehicle. A variable stability capability will be installed as an integral part of its control system. This installation will permit duplication of the dynamics of other VTOL vehicles, thus providing a unique research and development test capability.

The laboratory is moving into the second phase of development of air-cushion landing gear (ACLG) for aircraft. This involves deletion of the complete normal landing gear subsystem from the aircraft, including struts, retracting mechanisms, wheels, brakes and axles. The ACLG concept is based on the ground effect principle, employing a stratum of air instead of wheels as the aircraft ground contacting medium. A large rubber tube, over three feet in cross-sectional diameter when inflated, encircles the bottom of the aircraft fuselage and provides an air duct and seal for the air cushion. The tube is deflated in flight in a manner similar to de-icing boots on the leading edge of wings. The bottom of the tube contains a large number of nozzles through which the air passes into the air cushion cavity. Due to low ground overpressure (1 to 2 psi), this concept enables an aircraft to operate from surfaces now limited to swamp buggies. It is also highly resistant to small arms fire.

The same principle is used on air cushion vehicles (ACVs) which have already demonstrated their versatility, both as commercial ferries and as very useful military vehicles in South Vietnam. As an AFFDL-funded program in conjunction with Bell Aerospace Corp., the ACLG concept has experienced an evolutionary process from wind tunnel and dynamic free fall models to an actual flight test vehicle, the Lake LA–4. Floating on a cushion of air only a fraction of an inch above the ground, the LA–4 has demonstrated its unique abilities by operating routinely on snow, ice, rough terrain, and doughy mud strips, even under high cross-wind conditions. The next phase of this effort will be an advanced development program to equip a C–130 aircraft with an air cushion landing gear system.

A low-pressure sidewall-convoluted (expandable) tire has successfully completed a series of simulated takeoff and landing taxi cycles. Substituting such an expandable tire for a standard aircraft tire will double the possible flotation footprint and greatly decrease the gear stowage volume.

Technical leadership has been provided by the laboratory in the development of high lift to drag (L/D) ratio reentry flight vehicles. Beginning with basic investigations in hypersonic aerodynamics in the mid-1950s, the laboratory performed exploratory development in all flight vehicle technology areas associated with these types of vehicles, such as high temperature structures, flutter and vibration at hypersonic speeds, aerothermodynamics and flight control problems. The Aerothermodynamic/Elastic Structural Systems Environmental Test (ASSET) Program, consisting of six Thor missile-booster free flight test vehicles launched from Cape

Canaveral (now Cape Kennedy) during the period of 1963 through 1965, was conceived and conducted under the direction of AFFDL. Velocities up to 19,500 feet per second and altitudes greater than 200,000 feet were attained in acquiring basic data on vehicle areodynamics and environmental effects on reradiating structures and materials. The overall program of the laboratory in research on hypersonic flight vehicles is continuing. A recently proposed program in the low-speed regime might consist of the construction and subsequent manned flight testing of an approximately 7,000-pound high L/D vehicle at Edwards AFB, Calif. The vehicle would be dropped from a B–52 flying at an altitude of 40,000 feet and Mach .65.

Solution of Operational Problems

The expertise attained by laboratory personnel provides the quick response capability needed for solution of Air Force operational problems. Some past examples of such problems include:

- Sonic fatique on B–52 aircraft.
- Flow instability in the F–111 engine inlet.
- Vulnerability of Air Force aircraft to small arms fire.
- Wing crack propagation and fatigue life.
- Landing gear loads analysis and field experimentation.
- Improved flotation for tactical aircraft through tire deflation.
- Seat ejection injuries (Project Lifeline).
- AGM–12C structure/failure.

AFFDL personnel have participated in a number of aircraft review boards, such as the F–111, F–4, C–133 and B–58. An example of the application of the laboratory's capabilities to a particular weapon system problem was the F–111 engine-inlet compatibility study. A serious design deficiency restricted the operational envelope of this potentially important aircraft. Primary responsibility was given to the laboratory for isolating inlet problems and recommending changes. A comprehensive analysis of flight test and tunnel data was made to determine stall sensitivity with respect to flight Mach, angle of attack, engine airflow transients, inlet cowl and spike position, splitter plate and side plate behavior, and subsonic duct/compressor face pressure fluctuations. Causes of flow instability and pressure distortions were identified, and a series of inlet modifications to solve the problems were recommended.

The capability of the AFFDL inhouse experimental acoustic chamber to simulate high-intensity engine noise fields on components or full-scale flight vehicle structures makes possible unique contributions to the solution of operational problems, as well as the accomplishment of research and development objectives. Recent experimental programs include tests on such systems as the C–141, F–4C, F–4E, and F–111. Investigations of the acoustic fatigue resistance of new materials have involved filament structures, heat shields, and viscoelastic damped panel configurations. Inhouse exploratory development programs are serving to establish sonic fatigue design criteria for future structures. The demand for future acoustic test programs includes reliability experiments on Athena missile components, fatigue testing on the horizontal stabilizer of the EA–6A aircraft, and investigation of methods for reducing jet aircraft noise.

Resources available to AFFDL are, first and foremost, its military and civilian personnel, totaling 700 including over 400 scientists and engineers, of whom more than 100 hold advanced degrees. Total funds allotted to the laboratory in FY 1968 amounted to approximately $34 million. In-house experimentation and simulation facilities, used in carrying out the laboratory's mission, include a landing gear test facility (drop towers, dynamometers and a 1.4-million-pound tensile tester); a 50-megawatt hypersonic tunnel with a 30-minute run capability; a 2-foot supersonic tunnel; a large structures experimentation facility; a 1-megawatt acoustic test facility; a 12-foot diameter throat vertical wind tunnel; a complex of simulators for flight control experimentation; and equipment for combined vibration, temperature and "g" testing. The estimated replacement cost of the laboratory's facilities is $126 million.

As for the future, it is certain that, in the face of inflation and a relatively constant budget, selectivity will continue to be the keynote in determining the content of the laboratory program. The increasing cost and complexity, involved in conducting research and development and providing support for operational systems, requires even more effort to ensure that the critical future technical needs of the Air Force are discerned as early as possible and their solutions addressed in the laboratory program. In this regard, it is of interest to note that the capabilities of AFFDL were used as the DOD test laboratory for Project TORQUE (Technology or Research Quantitative Utility Evaluation), an experimental system for aiding laboratory and Service management in structuring a research and development program responsive to specified Service objectives.

In summary, the Air Force Flight Dynamics Laboratory provides the Air Force and the Defense Department, as well as industry, experienced interdisciplinary scientists and engineers who conduct programs designed to solve tomorrow's problems and provide a technology base which will preclude, to the greatest extent possible, the occurrence of these problems.

USACSC Establishes Two Support Groups

The U.S. Army Computer Systems Command (USACSC) has added two new field organizations to its command. The new USACSC Support Groups are located at the Presidio, San Francisco, Calif., and Fort Eustis, Va.

The Presidio support group was organized from personnel transferred from the Sixth Army Stock Control Center, Presidio, and is responsible for the continued development, fielding and support of the Centralization of Supply Management Operations Systems (COSMOS). COSMOS is a centrally designed system which will perform supply management and related techniques and communications via the AUTOVON and AUTODIN systems.

The second USACSC support group was organized around personnel transferred from the U.S. Continental Army Command Automated Systems Support Agency (CASSA), Fort Eustis, Va. Their responsibility is with the Continental Army Command Class I Automated System (COCOAS), designed to provide standard automatic data processing programs and hardware at installation level to meet management reporting requirements for financial, logistical and personnel data. A prototype system is currently in operation at Fort Sill, Okla.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Dr. Gardiner L. Tucker has assumed duties as Principal Dep. Dir., Defense Research and Engineering.

Lt. Gen. (designee) Timothy F. O'Keefe, USAF, has been selected for Dir. for Logistics, Office of the Joint Chiefs of Staff, Washington, D.C.

Lt. Gen. (designee) John W. Vogt Jr., USAF, is now Dir. for Operations, Office of the Joint Chiefs of Staff, Washington, D.C.

Dr. Donald B. Rice Jr. has been designated Dep. Asst. Secretary, Resources, Office of the Asst. Secretary of Defense (Systems Analysis).

Maj. Gen. Wendell E. Carter, USAF, Dep. Asst. Secretary of Defense, Information, Office of the Asst. Secretary of Defense (Comptroller), has retired.

Brig. Gen. (designee) Floyd H. Trogden, USAF, is the new Dep. Dir., Programs, Defense Communications Agency, Arlington, Va.

Col. Roger Ray, USA, has been designated Dep. Asst. to the Secretary of Defense, Atomic Energy.

The Defense Supply Agency, Alexandria, Va., has announced the following changes: **Maj. Gen. Daniel E. Riley, USAF,** assigned as Asst. Dir., Plans, Programs and Systems; **Brig. Gen. John A. Brooks III, USAF,** former Exec. Dir., Technical and Logistics Services, has retired; **Brig. Gen. Robert E. Lee, USAF,** former Exec. Dir., Procurement and Production, has retired; **Col. Henry M. Fletcher Jr., USAF,** assigned as Exec. Dir., Contract Administration Directorate; and **Capt. Jerome J. Scheela, SC, USN,** assigned as Dep. Comptroller.

DEPARTMENT OF THE ARMY

The Army Strategic Communications Command, Fort Huachuca, Ariz., has announced the following changes in command: **Maj. Gen. Hugh M. Foster** has taken command of STRATCOM-Pacific, Honolulu, Hawaii. He replaces **Brig. Gen. Robert D. Terry,** who became Dep. Dir., National Military Command System Support, Defense Communications Agency, Washington, D.C. **Brig. Gen. Irving R. Obenchain** has assumed duties as Commander, STRATCOM Safeguard Communications Agency, Fort Huachuca.

Mr. Leo Rachmel has been named Chairman of the newly formed Research Development Test and Evaluation Dept., Army Logistics Management Center, Fort Lee, Va.

Col. Ernest H. Davis is the new Dir., Concepts and Plans, Combat Developments Command, Fort Belvoir, Va.

The new Pershing Project Manager, Army Missile Command, Redstone Arsenal, Ala., is **Col. Rutledge P. Hazzard.**

Col. Russell J. Lamp has been assigned to the Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., as Commanding Officer.

Capt. Alfred W. Swan, SC, USN, has replaced **Col. Norman H. Gold, USA,** as Dir. of Freight Management, Military Traffic Management and Terminal Service, Washington, D.C.

DEPARTMENT OF THE NAVY

RAdm. Malcolm W. Cagle has been appointed Dir., General Planning and Programming Div., Office of the Chief of Naval Operations. **RAdm. George S. Morrison** has been chosen Dir., Electronic Warfare and Tactical Command Systems Div., Office of the Chief of Naval Operations.

RAdm. George E. Moore II, SC, replaces **RAdm. Nathan Sonenshein** as Dep. Chief of Naval Materiel (Logistic Support). RAdm. Sonenshein is the new Commander, Naval Ship Systems Command, Washington, D.C.

RAdm. Kenneth R. Wheeler, SC, has been assigned as Vice Commander, Naval Supply Systems Command.

RAdm. Mark W. Woods has moved up from Vice Commander, Naval Ordnance Systems Command, to Commander. The new Vice Commander is **RAdm. Frank H. Price Jr.**

Capt. Albion W. Walton, CEC, has been named Dep. for Acquisition, Naval Facilities Engineering Command, Washington, D.C.

Capt. Wayne J. Christensen is the new Commander, Northeastern Div., Naval Facilities Engineering Command, Boston, Mass. **Capt. Ralph B. Grahl,** CEC, has been named Commander, Eastern Div., Naval Facilities Engineering Command, New York, N.Y.

Capt. Donald A. Hempson, SC, has been assigned as Commander, Fleet Material Support Office, Mechanicsburg, Pa.

Capt. Frederick F. Jesett II has replaced **Capt. Eugene H. Simpson** as Commander, Naval Weapons Station, Seal Beach, Calif.

DEPARTMENT OF THE AIR FORCE

Lt. Gen. John W. Carpenter III has been reassigned as Asst. Vice Chief of Staff, Hq. USAF. His replacement as Dep. Chief of Staff, Personnel, is **Lt. Gen. Austin J. Russell.**

Lt. Gen. Robert G. Ruegg has replaced **Lt. Gen. Robert A. Breitweiser** as Commander in Chief, Alaskan Command. Lt. Gen. Breitweiser has retired.. **Lt. Gen. (designee) Harry E. Goldsworthy** has succeeded **Lt. Gen. Ruegg** as Dep. Chief of Staff, Systems and Logistics, Hq. USAF. **Maj. Gen. Donald W. Graham** is the new Asst. Dep. Chief of Staff, Systems and Logistics, Hq. USAF.

Lt. Gen. (designee) George B. Simler has been reassigned as Vice Commander in Chief, USAF Europe.

Hq., USAF, also announced the following changes: **Lt. Gen. Lucius D. Clay** has replaced **Lt. Gen. Glen W. Martin** as Dep. Chief of Staff, Plans and Operations. Gen. Martin is now Vice Commander in Chief, SAC, Offut AFB, Neb. **Mr. John J. Welch Jr.** has taken the position of Chief Scientist, Office of the Chief of Staff. **Dr. John C. Fisher,** former Chief Scientist, has left government service. **Lt. Gen. (designee) George S. Boylan Jr.** has been named Dep. Chief of Staff, Programs and Resources. **Maj. Gen. John M. McNabb** is the new Dir. of Plans, Office of the Dep. Chief of Staff, Plans and Operations, and **Maj. Gen. Andrew S. Low Jr.** has moved from Asst. for Logistics Planning, Office of the Dep. Chief of Staff, Systems and Logistics, to Dir. of Aerospace Programs, Office of the Dep. Chief of Staff, Programs and Resources. His replacement is **Brig. Gen. Peter R. Delonga. Maj. Gen. Edward M. Nichols Jr.** is now Dep. Inspector General for Inspection, Office of the Inspector General, Norton AFB, Calif. He replaces **Maj. Gen. Richard O. Hunziker,** who retired.

Maj. Gen. William C. Garland, former Dir., Office of Information, Office of the Secretary of the Air Force, has taken command of the First Strategic Aerospace Div., SAC, Vandenburg AFB, Calif. His replacement is **Brig. Gen. Henry L. Hogan III,** formerly Dep. Dir. The new Dep. Dir. of the Office of Information is **Brig. Gen. Thomas P. Coleman.**

Brig. Gen. Lew Allen Jr. is now Dir., Office of Space Systems, Office of the Secretary of the Air Force.

Maj. Gen. William H. Brandon is the new Dep. Dir. for Civil Disturbance Planning and Operations, Pentagon, Washington, D.C.

The Air Force Systems Command, Andrews AFB, Md., announced the following changes: **Lt. Gen. John W. O'Neill** became Vice Commander, AFSC, on Sept. 1 replacing **Lt. Gen. Charles H. Terhune Jr.** who has retired. **Lt. Gen. Samuel C. Phillips** replaced Lt. Gen. O'Neill as Commander, Space and Missile Systems Organization. **Brig. Gen. John B. Hudson** replaced **Maj. Gen. Vincent G. Huston** as Dep. Chief of Staff, Operations, AFSC. **Brig. Gen. David V. Miller** has moved from Commander, Special Weapons Center, Kirtland AFB, N.M., to Dep. Chief of Staff, Personnel, AFSC. **Col. Edward R. Feicht** has succeeded **Col. Edwin W. Brown** as Vice Commander, Arnold Engineering Development Center, Arnold AFS, Tenn.

Brig. Gen. Ralph T. Holland is the new Vice Commander, Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga., and **Col. Charles J. Beck** has replaced **Brig. Gen. Jowell C. Wise** as Vice Commander, Ogden Air Materiel Area, AFLC, Hill AFB, Utah. Brig. Gen. Wise retired.

AFSC Realigns F–15 Program

The Air Force Systems Command, Andrews AFB, Md., has announced several organizational changes in the F–15 program directed at strengthening management and streamlining channels.

The Systems Program Director, located at Wright-Patterson AFB, Ohio, will report directly to the Commander, AFSC, instead of being subordinate to AFSC's Aeronautical Systems Division. No physical move is involved, however, and the Aeronautical Systems Division will continue to support the program.

Simultaneously, Brigadier General (designee) Benjamin N. **Bellis** has been assigned to direct the program, in line with Air Force practice to put major systems development under general officer supervision. Colonel Bob White, who organized and directed the Systems Program Office from its inception, will continue as General **Bellis'** deputy.

The third change involves the transfer of the F–15 monitoring responsibility from the Pentagon to AFSC headquarters. Colonel R. K. McIntosh has been named to fill the new position, Assistant to the Commander for the F–15, with the responsibility for F–15 matters in the Washington area.

Army Engineers Test Plastic Sealed Roads

Plastic-wrapped roads, designed to cut costs and construction time in combat areas, are under test by the Army Corps of Engineers. The plastic wrapper enables road builders to substitute fine grain subgrade materials, such as clay soils native to a road site, for a granular base, eliminating locating and quarrying rock, crushing it, and hauling it to the road site.

The wrapper, actually polypropylene fibers inserted into a cotton scrim, is made in 15-by-300-foot sections. In use, the plastic is laid over the prepared roadbed, and covered with a layer of asphalt and subgrade material. This sandwich is then compacted and covered with a second layer of plastic. The two layers of polypropylene are then sealed, covered with a final layer of asphalt, and the road is ready for use.

The plastic, according to Corps spokesmen, acts as a waterproof seal against subsurface moisture seeping up and as a reinforcement for the asphalt, permitting much greater deflection under traffic than asphalt alone.

The concept is undergoing tests at the Corps Waterways Experiment Station, Vicksburg, Miss., and at Dyess AFB, Tex. At Vicksburg, a membrane encasement has been successfully tested with military convoy traffic of 2½- and 5-ton cargo trucks. In another test, an 18-inch layer of clay sealed in the membrane supported 2,000 passes of a 25,000-pound single wheel load.

The tests, according to the Corps, indicate that the combination of polypropylene and asphalt can be used for waterproofing and dustproofing roads, street hardstands and even air terminals.

Army Unveils New Air Target System

A new Ballistic Aerial Target System (BATS) for Redeye, Chaparral and Vulcan training has been proposed for procurement by the Army Combat Developments Command (CDC), Fort Belvoir, Va. BATS would provide a low-cost, troop-operated, booster-propelled aerial target system offering realistic training for forward area air defense systems, present and future.

CDC envisions BATS as having a portable launcher, enabling emplacement by troops within two hours, using unit hand tools. In flight, BATS would be capable of maintaining stable flight and structural integrity at three intermediate speeds between 300 and 500 knots.

With a broadside target area of 30 square feet, BATS would have a hit determination indicator for gunner evaluation, and possess an infrared signature compatible with Redeye and Chaparral missile systems. BATS could also have a self-destruct device, sensitive to excessive deviation from a safe trajectory, if deemed necessary during early tests.

Finally, BATS would be operable in all climates, having a maximum range of 12,000 feet at 2,000 feet altitude, and have a troop training time of under 8 hours.

MEETINGS AND SYMPOSIA

SEPTEMBER

Seventh Annual **Defense and Government Procurement** Conference, Sept. 4-5, at the Rackham Memorial Building, Detroit, Mich. Sponsor: Defense and Government Contracts Management Association. Contact: Frank R. Light, Conference Chairman, Exec. Vice President, Continental Aviation and Engineering, Div. of Continental Motors Corp., 12700 Kercheval Ave., Detroit, Mich. 48215.

Advanced Planning Briefing for Industry on **Naval Aeronautics/Astronautics** (classified), Sept. 23-25, at Battelle Memorial Institute Columbus Laboratories, Columbus, Ohio. Co-sponsors: Naval Material Command and National Security Industrial Association. Contact: Paul A. Newman, National Security Industrial Association, 1030 15th Street NW, Suite 800, Washington, D.C. 20005. Phone (202) 296-2266.

V/STOL Technology and Planning Conference, Sept. 23-25, Las Vegas, Nev. Sponsor: Air Force Flight Dynamics Laboratory. Contact: Lt. Col. Jay D. Pinson, Conference Chairman, Dir., V/STOL Division, Flight Dynamics Laboratory, AFSC, Wright-Patterson AFB, Ohio 45433.

OCTOBER

Fifty-first **Defense Preparedness** Meeting, Oct. 1-2, at The Sands Hotel, Las Vegas, Nev. Co-sponsors: American Ordnance Association and U.S. Air Force. Contact: Col. John R.V. Dickson, American Ordnance Association, Transportation Building, 815 17th Street NW, Washington, D.C. 20006. Phone (202) 347-7250.

Biological Molecules in Their Excited States Symposium, Oct. 5-9, at Columbia University, New York, N.Y. Sponsors: U.S. Army Research Office-Durham, Hoffman-La Roche, and the American Instrument Company. Contact: Dr. George M. Wyman, Director, Chemistry Division, U.S. Army Research Office-Durham, Box CM, Duke Station, Durham, N.C. 27706. Phone (919) 286-2285.

International **Blood Oxygenation** Symposium, Oct. 6–8, at the University of Cincinnati, Ohio. Co-sponsors: U.S. Army Medical Research and Development Command, and the College of Engineering, University of Cincinnati. Contact: Col. Lawrence R. Rose, MC, Chief, Surgical Research Division, U.S. Army Medical Research and Development Command, Washington, D.C. 20315. Phone (202) OXford 6–6082.

Annual **Association of the United States Army** Meeting, Oct. 13—15, Sheraton-Park Hotel, Washington, D.C. Sponsor: Association of the United States Army. Contact: Brig. Gen. Robert F. Cocklin, USAR, Association of the United States Army, 1529 18th St., NW, Washington, D.C. 20036. Phone (202) 483–1800.

Configuration Management Workshop, Oct. 20-24, at Shelbourne Hotel, Atlantic City, N.J. Sponsor: Electronic Industries Association. Contact: Jack F. Hessman, Electronic Industries Association, 2001 I Street NW, Washington, D.C. 20006. Phone (202) 659-2200.

Fifteenth **Design of Experiments in Army Research, Development and Testing** Conference, Oct. 22–24, Redstone Arsenal, Ala. Sponsors: U.S. Army Research Office-Durham, and the Army Mathematics Steering Committee of the Office of the Army Chief of Research and Development. Contact: Dr. Francis G. Dressel, Mathematics Division, U.S. Army Research Office—Durham, Box CM, Duke Station, Durham, S.C. 27706. Phone (919) 286–2285, Ext. 75.

EASCON '69 Electronics and Aerospace Systems Convention and Exposition, Oct. 27-29, at the Sheraton Park Hotel, Washington, D.C. Sponsor: Aerospace and Electronic Systems Group, Institute of Electrical and Electronics Engineers. Contact: Robert M. Johnson, General Electric, 777 14th Street NW, Washington, D.C. 20005. Phone (202) 393-3600, Ext. 207; or Col. James M. Templeman, Office of Assistant Chief of Staff, Communications & Electronics, Department of the Army, 2E 258 Pentagon, Washington, D.C. 20310. Phone (202) OXford 7-1279.

NOVEMBER

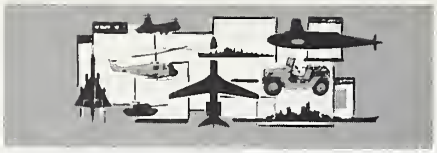
Second Annual **Armed Forces Audio-Visual Communications** Conference, Nov. 3-7, at the Sheraton-Park Hotel, Washington, D.C. Sponsor: Department of the Army. Contact: HQUSAF (AFXO-TV), 2AFAVCC Registration Committee, Washington, D.C. 22030. Phone (202) 693-2615.

Fifteenth Annual Army **Human Factors Research and Development** Conference, Nov. 4-6, at Fort Ord, Calif. Sponsor: Behavorial Sciences Division of the Office of the Chief of Army Research and Development. Contact: Lynn E. Baker, U.S. Army Chief Psychologist, Behavorial Sciences Division, Office of the Chief of Research and Development, Department of the Army, Washington, D. C. 20310. Phone (202) OXford 4-3693.

VTOL **Environmental Requirements** Symposium, Nov. 17-18, at Arlington, Tex. Sponsors: Aeronautical Systems Division (AFSC), American Helicopter Society, and the University of Texas. Contact: Mr. Kuehne, Aeronautical Systems Division (ASZT), Wright-Patterson AFB, Ohio 45433. Phone (513) 255-3224.

Fourth Naval Training Device Center and Industry **Cost Effective Training Devices** Conference, Nov. 18-20, at the Naval Training Center, Orlando, Fla. Sponsor: Naval Training Device Center. Contact: D. Robert Copeland, Conference Coordinator, Code 421, Naval Training Device Center, Orlando, Fla. 32813. Phone (305) 841-5611 Ext. 664.

Titanium Technical Conference, Nov. 18-20, at Dayton, Ohio. Co-sponsors: Air Force Materials Laboratory and the University of Dayton Research Institute. Contact: Dr. Gegel, Air Force Materials Laboratory (MAMS), Wright-Patterson AFB, Ohio 45433. Phone (513) 255-5561.



DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of July 1969.

DEFENSE SUPPLY AGENCY

1—The Defense General Supply Center, Richmond, Va., awarded the following contracts for sandbags:

Crowley Industrial Bag Co., Inc. Crowley, La. $3,030,388. 4,790,000 polypropylene and 10,000,000 acrylic. DSA 400-70-C-0009.

Consolidated Bag Corp., Philadelphia, Pa. $2,322,540. 9,200,000 acrylic. DSA 400-70-C-0005.

Kane Bag Supply Co., Baltimore, Md. $1,731,925. 5,000,000 polypropylene and 5,000,000 acrylic. DSA 400-70-C-0006.

Bemis Co., Inc., Minneapolis, Minn. $1,033,908. 2,540,000 polypropylene and 3,090,000 acrylic. Norfolk, Va., and New Orleans, La. DSA 400-70-C-0003.

7—**Humble Oil Refining Co.**, Houston, Tex. $1,483,100. Fuel oil and gasoline. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-2368.

—**Kentucky Appalachian Industries, Inc.**, Prestonsburg, Ky. $1,133,334. Wet weather parkas. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0017.

—**Brownwood Manufacturing Co.**, Dallas, Tex., $1,077,468. Men's raincoats for the Air Force. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0016.

8—**Burlington Industries, Inc.**, New York, N.Y. $2,891,830. 961,000 yards of Air Force Blue serge cloth. Raeford, N.C., Halifax and Clarksville, Va. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0001.

9—**Consolidated Bag Corp.**, Philadelphia, Pa. $2,312,631. 9,200,000 acrylic sandbags. Defense General Supply Center, Richmond, Va. DSA 400-70-C-0005.

—**Kane Bag Supply Co.**, Baltimore, Md. $1,837,427. 5,000,000 polypropylene and 5,000,000 acrylic sandbags. Defense General Supply Center, Richmond, Va. DSA 400-70-C-0006.

—**United Bag, Inc.**, St. Louis, Mo. $1,011,652. 4,000,000 acrylic sandbags. Defense General Supply Center, Richmond, Va. DSA 400-70-C-0004.

11—**Hess Oil and Chemical Corp.**, Woodbridge, N.J. $2,973,661. Fuel oil and gasoline for delivery to installations in the East. Defense Fuel Supply Center, Alexandria, Va. DSA 600-69-D-2366.

—**Gulf Oil Corp.**, Houston, Tex. $5,342,759. Fuel oil and gasoline for delivery to installations in the East. Defense Fuel Supply Agency, Alexandria, Va. DSA 600-69-D-2364.

—**Genesco, Inc.**, Nashville, Tenn. $1,106,842. 166,668 pairs of men's black oxford dress shoes. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0075.

18—**Singleton Packing Corp.**, Tampa, Fla. $1,042,214. 95,616 cans of cooked, dehydrated shrimp. Defense Personnel Support Center, Philadelphia, Pa. DSA 130-70-C-E002.

22—**Rachman Manufacturing Co.**, Reading, Pa. $2,560,219. 110,880 body armor fragmentation protective vests for the Republic of Vietnam Armed Forces. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0126.

—**Lester D. Lawson and Co.**, Long Beach, Calif. $4,564,657. 163,140 cases of ration supplement, sundries pack. Brookley AFB, Ala. Defense Personnel Support Center, Philadelphia, Pa. DSA 134-70-C-0032.

24—**Stauffer Chemical Co.**, New York, N.Y. $2,986,140. 3,140,000 one-quart cans of aircraft turbine lube oil. Gallipolis Ferry, W. Va. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-C-0233.

25—**Chevron Oil Co.**, Perth Amboy, N.J. $1,042,694. Various quantities of fuel and gasoline for installations in New England. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-D-0011.

—**Gulf Oil Co.**, Houston, Tex. $1,346,322. Fuel oil and gasoline for installations in New England. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-C-0033.

—**Union Oil Co. of Boston**, Revere, Mass. $1,148,509. Fuel oil and gasoline for installations in New England. Defense Fuel Supply Center, Alexandria, Va. DSA 600-70-D-0083.

—**Henderson Manufacturing Co., Inc.**, Lumberton, N.C. $1,011,050. 365,000 men's wind-resistant cotton coats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0155.

31—**MacShore Classics, Inc.**, New York, N.Y. $1,365,000. 500,000 men's cotton coats. Woodruff, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0208.

—**Cavalier Bag Co., Inc.**, Lumberton, N.C. $2,345,220. 9,090,000 acrylic sandbags. Defense General Supply Center, Richmond Va. DSA 400-70-C-0008.

—**Pembroke, Inc.**, Egg Harbor City, N.J. $1,008,008. 42,532 men's wool serge overcoats. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-70-C-0182.

—**Sparling Mills, Inc.**, Greenville, R. I. $1,011,360. 4,000,000 acrylic sandbags. Lumberton, N.C. Defense General Supply Agency, Richmond, Va. DSA 400-70-C-0447.

DEPARTMENT OF THE ARMY

1—**Martin Marietta Corp.**, Orlando, Fla. $4,111,387. Modification kit installation and modified equipment training for the Pershing. Army Missile Command, Huntsville, Ala. DA-AHO1-70-C-0005.

—**Control Data Corp.**, Honolulu, Hawaii. $3,500,000. Development and analysis in support of the Military Assistance Command, Vietnam pacification program. Work will be done in Vietnam. Army Missile Command, Huntsville, Ala. DA-AHO1-70-C-0009.

—**Raytheon Co.**, Andover, Mass. $1,932,422. Basic Hawk engineering services product assurance, practice field facilities and an improvement team. Army Missile Command, Huntsville, Ala. DA-AHO1-70-C-0384.

—**IBM Corp.**, Gaithersburg, Md. $2,105,948. (contract modification). Combat services support system. Army Electronics Command, Alexandria, Va. DA-AB07-67-C-0408.

—**Kentron, Hawaii, Ltd.**, Honolulu, Hawaii. $1,656,156. Specialized services to support maintenance and calibration standards of test equipment in the Pacific Theater. Vietnam, Thailand and Okinawa. Army Purchasing and Contracting Office, Hawaii. DA-GA01-69-C-0357.

—**Nurrie Construction Co.**, Muskogee, Okla. $1,034,731. Construction of recreational facilities in Jefferson County, Kansas. Army Engineer District, Kansas City, Mo. DA-CW41-70-C-0001.

2—**LTV Electrosystems, Inc.**, Huntington, Ind. $8,554,746. Components of AN/VRC-12 vehicular radio sets for tactical use. Army Electronics Command, Philadelphia, Pa. DA-AB05-67-C-0171.

—**Urban Systems Development Corp.**, Arlington, Va. $3,724,002. Construction of 200 family housing units, Fort Meade, Md. Army Engineer District, Baltimore, Md. DA-CA31-70-C-0001.

—**Sylvania Electric Products, Inc.**, Williamsville, N.Y. $2,246,000 (contract modification). Burn-in spare parts for AN/ARC-114, 115 and 116 radio sets and AN/ARN-89 automatic direction finder. Buffalo, N.Y. Army Electronics Command, Fort Monmouth, N.J. DA-28-043-AMC-01943(E).

3—**Sides Construction Co.**, Omaha, Neb. $1,051,526. Alterations to Headquarters Building, Offut AFB, Neb. Army Engineer District, Omaha, Neb. DA-CA45-70-C-0003.

7—**Firestone Tire and Rubber Co.**, Akron, Ohio. $1,269,500. Road wheel assemblies for the M113 armored personnel carriers. Noblesville, Ind. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-5144.

—**Goodyear Tire and Rubber Co.**, Akron, Ohio. $1,076,470. Track shoe assemblies for M108 and M109 howitzers. St. Mary's, Ohio. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4492.

9—**Bell Helicopter Co.**, Fort Worth, Tex. $1,898,248. Rotary rudder blades for UH-1 helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

—**Riddle Contracting Co.**, Salina, Kan. $1,273,290. Construction and excavation work, Douglas and Leavenworth Counties, Kan. Army Engineer District, Kansas City, Mo. DA-CW41-70-C-0002.

10—**General Electric Co.**, Portland, Ore. $4,049,000. Fabrication and installation of 135-MW generators at the John Day Lock and Dam, near Dalles, Ore. Army Engineer District, Walla Walla, Wash. DA-CW68-70-C-0007.

—**Gregg, Gibson and Gregg, Inc.**, Leesburg, Fla. $1,676,687. Construction of a spillway structure and approximately one mile of canal, and raising 900 feet of levee in connection with the Central and Southern Florida Project, Okeechobee County, Fla. Army Engineer District, Jacksonville, Fla. DA-CW17-70-C-0004.

11—**Mohawk Rubber Co.**, Akron, Ohio. $1-285,428. 12-ply rubber tires for 5-ton trucks. West Helena, Ark., and Salem, Va. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-0002.

15—**Mine Safety Appliances Co.**, Pittsburgh, Pa. $4,793,071. Second and third increment of multi-year procurement of protective field masks. Esmond, R. I. Edgewood Arsenal, Md. DA-AA15-67-C-0265.

—**Rubin Construction Co.**, West Palm Beach, Fla. $2,637,193. Excavation of 4½ miles of canal from the southwest side of Lake Okeechobee through Moorehaven, Fla. Army Engineer District, Jacksonville, Fla. DA-CW17-70-C-0006.

16—**A. G. Schoonmaker, Inc.**, Sausalito, Calif. $1,236,910. Diesel generator sets. Army Engineer District, San Francisco, Calif. DA-CA07-70-C-0005.

—**Missouri Research Laboratories**, St. Charles, Mo. $1,083,498 (contract modification). Service ward units (MUST hospital). Army Mobility Equipment Command, St. Louis, Mo. DA-AK01-68-C-8162.

17—**Harvey Aluminum Sales, Inc.**, Torrance,

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—Company — Value — Material or Work to be Performed—Location of Work Performed (if other than company plant) — Contracting Agency—Contract Number.

Calif. $1,736,608 (contract modification). Building expansion, and conversion and acquisition of non-production equipment, Army Ammunition Plant, Milan, Tenn. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-11-173-AMC-00520(A).

—**H. Earl Parker, Inc.**, Marysville, Calif. $1,335,556. Bank protection work on the Sacramento River between Sacramento and Tisdale Weir, Calif. Army Engineer District, Sacramento, Calif. DA-CW05-70-C-0008.

18—**Al Johnson Construction Co.**, Minneapolis, Minn. $7,859,743. Construction of intake structures and tunnel liners at Carter's Dam, Ga. Army Engineer District, Mobile, Ala. DA-CW01-70-C-0008.

—**Bristol Electronics, Inc.**, New Bedford, Mass. $2,022,282 (contract modification). AN/PRC-25 radio sets. Army Electronics Command, Philadelphia, Pa. DA-36-0390-AMC-07306(E).

—**Colt's Inc.**, Hartford, Conn. $41,158,294. 458,435 M-16 rifles. Army Weapons Command, Rock Island, Ill. DA-AF03-70-C-0001.

—**General Motors Corp.**, Ypsilanti, Mich. $23,783,556. 229,217 M-16 rifles. Army Weapons Command, Rock Island, Ill. DA-AF03-70-C-0002.

22—**Holt Brothers**, Stockton, Calif. $1,661,652 (contract modification). 200 general purpose generator sets. Army Mobility Equipment Command St. Louis, Mo. DA-AK01-69-C-5230.

23—**AVCO Corp.**, Charleston, S.C. $5,323,500. Overhaul and/or repair of T53-L-13/13A turbine engines for UH-1H and AH-1G aircraft. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0308.

—**Flinchbaugh Products, Inc.**, Hampton, Va. $2,933,400. Metal parts for 152mm projectiles (XM409E2). Picatinny Arsenal, N.J. DA-AA21-70-C-0045.

24—**The Case Western Reserve University**, Cleveland, Ohio. $1,500,000. Computer research and development. Army Electronics Command, Fort Monmouth, N.J.

25—**RCA**, Van Nuys, Calif. $1,653,019. Signal adapters for the AN/ASH voice warning system and signal adapter test sets. Army Electronics Command, Fort Monmouth, N.J. DA-AB07-70-C-0024.

—**Bell Helicopter Co.**, Fort Worth, Tex. $32,608,309. OH-58A light observation helicopters and related data. Hurst, Tex., and Beech Aircraft Corp., Wichita, Kans. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-68-C-1699.

—**Western Electric Co., Inc.**, New York, N.Y. $4,300,000. Installation of kits for the Nike Hercules weapon system at overseas locations. Army Missile Command, Huntsville, Ala. DA-AH01-68-A-0041.

—**Continental Motors Corp.**, Muskegon, Mich. $4,561,729. Cylinder assemblies for engines for M-60 tanks. Muskegon and Oberdorfer Foundries, Inc., Syracuse, N.Y. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-4844.

28—**Litton Systems, Inc.**, Sunnyvale, Calif. $3,100,000 (contract modification). Scientific and technical effort to support experimentation for the Combat Developments Command, Experimental Command. Fort Ord, Calif., and Hunter-Liggit Military Reservation, King City, Calif. San Francisco Procurement Agency, Pasadena, Calif. DA-AG05-67-C-3096(X).

29—**S. J. Graves and Sons Co.**, Ann Arbor, Mich. $3,106,731. Relocation of 4½ miles of local and township roads in Eric County, Pa., in connection with the Union City Reservoir Project. Army Engineer District, Pittsburgh, Pa. DA-CW59-70-C-0007.

—**Stevens Manufacturing Co.**, Ebensburg, Pa., $1,726,674 (contract modification). Potable water tank trailers. Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-1461.

30—**Lockheed Aircraft Corp.**, Plainfield, N.J. $1,490,666. AN/VPS-2 radars and XM163 installation kits for the Vulcan Air Defense System. Army Procurement Agency, New York, N.Y. DA-AA25-69-C-0196.

31—**Western Electric Co.**, New York, N.Y. $80,000,000. Research and development contract extension for Safeguard studies through Sept. 15.

—**Ford Motor Co.**, Dearborne, Mich. $2,034,475 (contract modification). Engineering support for M151 and M718 series trucks. Army Tank Automotive Command, Warren, Mich. DA-AE07-68-C-2998.

—**Weatherhead Co.**, Cleveland, Ohio. $1,578,000 (contract modification). Metal parts for 105mm projectiles. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0115.

—**CONDEC Corp.**, Old Greenwich, Conn. $1,503,300 (contract modification). Engineering services in support of production of the M561 truck (Gamma Goat). Army Tank Automotive Command, Warren, Mich. DA-AE07-69-C-0144.

—**Bell Aerospace Corp.**, Fort Worth, Tex. $1,482,546. Rotary wing hubs for UH-1 helicopters, Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

—**General Time Corp.**, Stamford, Conn. $1,463,200 (contract modification). Metal parts for 105mm through 155mm artillery shells. Thomaston, Ga. Army Ammunntion Procurement and Supply Agency, Joliet, Ill. DA-AA09-69-C-0409.

—**Hughes Aircraft Co.**, Culver City, Calif. $1,304,718. TOW missile research and development. Army Missile Command, Huntsville, Ala. DA-AH01-70-C-0097.

—**General Motors Corp.**, Indianapolis, Ind. $1,187,025 (contract modification). T-63 turbine engines for light observation helicopters. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-C-00140.

—**Standard Container Co.**, Montclair, N.J. $1,106,215 (contract modification). Ammunition packaging boxes for .30 caliber and 7.62mm linked ammunition. Homerville, Ga. Frankford Arsenal, Philadelphia, Pa. DA-AA25-69-C-0308.

—**Hayes International Corp.**, Birmingham, Ala. $1,094,944. Metal parts for M151 (2.75 inch rocket) warheads. Cincinnati Procurement Agency, Cincinnati, Ohio. DA-AA09-69-C-0135.

DEPARTMENT OF THE NAVY

1—**Airborne Instruments Laboratory, Inc.**, Long Island, N.Y. $18,113,010. Aircraft carrier aircraft approach control system equipment. Deer Park, N.Y. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1300.

—**Westinghouse Electric Corp.**, Washington, D.C. $16,931,250. Poseidon launcher and handling equipment. Sunnyvale, Calif. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0138.

—**Raytheon Co.**, Lexington, Mass. $9,600,000. Production of AN/SPG-51D dual radar sets and ancillary equipment for Tartar D missiles. North Dighton, Mass. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2409.

—**Hazeltine Corp.**, Little Neck, N.Y. $5,833,930. AN/AGSQ-141/142 acoustic-seismic detection transmitting sets for the Army and Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0617.

—**Sperry Rand Corp.**, St. Paul, Minn. $2,533,311. Research and development on airborne navigation systems. Naval Air Systems Command, Washington, D.C. N00019-69-C-0695.

—**Clevite Corp.**, Cleveland, Ohio. $1,500,000. Production of Mk 48 Mod 1 torpedo, components, and associated equipment. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-1426.

—**IBM Corp.**, Arlington, Va. $1,348,426. Computer equipments and services for seven Naval Industrial Air Stations. Naval Automatic Data Processing Equipment Systems Office, Washington, D.C. 1066032-62-L-0007.

—The Naval Ship Systems Command, Washington, D.C., awarded the following contracts for definition efforts on the AN/BQs submarine sonar system:

Raytheon Co., Portsmouth, R. I. $1,250,000. N00024-69-C-1452.

Sperry Rand Corp., $1,150,000. N00024-69-C-1453.

IBM Corp., Owego, N.Y. $1,099,429. N00024-69-C-1454.

General Electric Co., Syracuse, N.Y. $1,200,000. N00024-69-C-1455.

2—**Collins Radio Co.**, Richardson, Tex. $4,863,961. Various components for use in the Naval Tactical Data System. Richardson and Cedar Rapids, Iowa. Naval Ship Systems Command, Washington, D.C. NObsr-95244.

—**Newport News Shipbuilding and Dry Dock Co.**, Newport News, Va. $22,013,670 (contract modification). Overhaul, refueling and alteration of USS Daniel Webster (SSBN 626). Naval Ship Systems Command, Washington, D.C. N00024-68-C-0308.

—**Raytheon Co.**, Lexington, Mass. $18,171,030. Sparrow III guidance and control groups for the Navy and Air Force. Lowell and Bedford, Mass., Oxnard, Calif., and Bristol, Tenn. N00019-68-C-9386. $5,626,244. Sparrow III guidance and control sections. N00019-68-C-0386. Naval Air Systems Command, Washington, D.C.

—**Hazeltine Corp.**, Little Neck, N.Y. $4,667,144. Classified electronic equipment. Naval Air Systems Command, Washington, D.C. N00019-69-C-0617.

—**North American Rockwell Corp.**, McGregor, Tex. $2,040,698. Rocket motors for Shrike and Sparrow missiles. Naval Air Systems Command, Washington, D.C. N00019-69-C-0215.

—**LTV Aerospace Corp.**, Dallas, Tex. $1,347,120. TF-41-A-2 engine flight tests. Naval Air Systems Command, Washington, D.C. N00019-68-C-0075.

3—**Johns Hopkins University**, Silver Spring, Md. $3,419,960. Increase the level of effort on advanced research on surface missile system. Naval Ordnance Command, Washington, D.C. NOW62-0604-C.

—**Vitro Corp. of America**, Silver Spring, Md. $1,987,178. Increase in engineering services and support for surface missile systems. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-4415.

—**Westinghouse Electric Corp.**, Baltimore, Md. $1,500,000. Engineering support for Mark 48 torpedo. Landsdowne, Md. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-0162.

—**Cates Construction Co., Inc.**, Dallas, Tex. $1,104,000. Construction of bachelor enlisted quarters, Naval Air Station, Chase Field, Tex. Naval Facilities Engineering Command, Washington, D.C. N62468-69-C-0162.

7—**FMC Corp.**, Minneapolis, Minn. $22,683,106. Mark 13, Mods 1 and 3, guided missile launching systems and ancillary equipment. Fridley, Minn. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2208.

—**General Electric Co.**, Pittsfield, Mass. $4,389,000. Poseidon missile training system services and material. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0128.

—**Transit Tank International Inc.**, Richmond, Calif. $1,805,751. Petroleum asphalt. Naval Purchasing Office, Los Angeles, Calif. N00123-69-C-1674.

—**Norris Industries**, Vernon, Calif. $1,791,739. War heads and motor cases for five-inch 38 caliber projectiles. Naval Ordnance Station, Indian Head, Md. N00174-70-C-007.

—**Sylvania Electronic Systems, Inc.**, Mountain View, Calif. $1,471,500. Classified electronic equipment. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1447.

—**McDonnell Douglas Corp.**, St. Louis, Mo. $356,713,045. F-4J, RF-4C and F-4E aircraft for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0521.

—**Boeing Co.**, Morton, Pa. $33,123,680. CH-46D helicopters. Naval Air Systems Command, Washington, D.C. N00019-69-C-0562.

—**Grumman Aircraft Engineering Corp.**, Bethpage, N.Y. $9,680,700 (contract modification). Modification kits for the E-2A aircraft program. Naval Air Systems Command, Washington, D.C. N00019-67-C-0657.

—**Collins Radio Co.**, Cedar Rapids, Iowa. $6,626,502. Airborne communication, navigation and identification equipment components. Naval Air Systems Command, Washington, D.C. N00019-69-C-0527.

—**Hughes Aircraft Co.**, Culver City, Calif. $4,740,305 (contract modification). Phoenix missiles. N0019-68-C-0240. $2,301,634 (contract modification). Incremental funding for Pheonix missiles. N00019-67-C-0240. $2,000,000 (contract modification). Incremental funding for Phoenix missiles.

NOw 63-0379. Naval Air Systems Command, Washington, D.C.

—**Electronic Communications, Inc.**, St. Petersburg, Fla. $2,483,465. Airborne UHF telemetry transmitters. Naval Air Systems Command, Washington, D.C. N00019-69-C-0665.

—**Sparton Corp.**, Jackson, Mich. $1,200,000. AN/SSQ-50 sonobuoys. Naval Air Systems Command, Washington, D.C. N00019-69-C-0650.

—**Sundstand Corp.**, Rockford, Ill. $1,775,274 (contract modification). Constant speed drive units for the Air Force. Naval Air Systems Command, Washington, D.C. N00019-68-C-0083.

8—**United Aircraft Corp.**, Stratford, Conn. $18,087,682. HH-53C helicopters for the Air Force. N00019-69-C-0620. $9,575,156. CH-53C helicopters for the Air Force. N00019-69-C-0621. $2,431,533 (contract modification). HH-53 helicopters for the Air Force. N00019-68-C-0627. Stratford and Bridgeport, Conn. Naval Air Systems Command, Washington, D.C.

—**Hughes Aircraft Co.**, Culver City, Calif. $7,500,000. Phoenix missile program. Tucson, Ariz., Culver City, Los Angeles, El Segundo, and Canoga Park, Calif. Naval Air Systems Command, Washington, D.C. N00019-69-C-0621.

—**Raytheon Co., Inc.**, North Dighton, Mass. $2,225,930. Mark 72 Mod O signal data converters and associated equipment. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-2323.

—**Raytheon Co., Inc.**, Sudbury, Mass. $3,435,766 (contract modification). Poseidon guidance systems. Naval Strategic Systems Project Office, Washington, D.C. N00030-66-C-0159 PO11.

—**General Electric Co.**, Washington, D.C. $3,878,751 (contract modification). Guidance systems for Poseidon missiles. Pittsfield, Mass. Naval Strategic Systems Project Office, Washington, D.C. N00030-66-C-0184 PO11.

—**Singer General Precision Inc.**, Wayne, N.J. $9,000,000 (contract modification). Guidance systems for Poseidon missiles. Naval Strategic Systems Project Office, Washington, D.C. N00030-69-C-0086 POO6.

—**Westinghouse Electric Corp.**, Baltimore, Md. $3,332,118. Increased funding for the complete integration of the Mark 27 Mod O sonar tracking system into production prototype targets. Naval Ordnance Systems Command, Washington, D.C. W-64-0705-i.

—**Norfolk Shipbuilding and Drydock Co.**, Norfolk, Va. $1,827,200. Regular overhaul of the USS Fort Mandan (LSD 21). Supervisor of Shipbuilding, Conversion and Repair, Fifth Naval District.

—**Horne Brothers, Inc.**, Newsport News, Va. $1,678,765. Regular overhaul of the USS Chilton (LPA 38). Supervisor of Shipbuilding, Conversion and Repair, Fifth Naval District.

9—**Massachusetts Institute of Technology**, Cambridge, Mass. $3,000,000 (contract modification). Incremental funding for Poseidon advanced guidance systems. N0030-69-C-0089 POO3. $4,849,885 (contract modification). Poseidon guidance systems. N00030-66-C-0189 PO11. Naval Strategic Systems Project Office, Washington, D.C.

—**Control Data Corp.**, Bethesda, Md. $3,957,012. Engineering services for the Fleet Ballistic Missile Training System, and technical services for Poseidon and Polaris missiles. Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0005.

—**Sangamo Electric Co.**, Springfield, Ill. $3,190,433. Detecting ranging sonars, transducers, associated repair parts and data, and engineering services and support. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1458.

10—**CGS Scientific Corp.**, Southampton, Pa. $1,307,750. Construction of a compression chamber at the Naval Submarine Medical Center, Groton, Conn. Naval Facilities Engineering Command, Washington, D.C. N62319-69-C-0021.

11—**Lockheed Missile and Space Co.**, Sunnyvale, Calif. $102,313,868 (contract modification). Poseidon missiles and related equipment. Naval Strategic Systems Project Office, Washington, D.C. N00030-66-C-0186.

—**Vitro Corp.**, Silver Spring, Md. $12,894,991. Engineering services for fleet ballistic missile systems (Polaris and Poseidon). Naval Strategic Systems Project Office, Washington, D.C. N00030-70-C-0010.

—**Bendix Corp.**, Baltimore, Md. $1,211,379 (contract modification). Airborne receiver transmitter and associated equipment for the Air Force. Naval Air Systems Command, Washington, D.C. NOw 66-0637.

14—RCA, Moorestown, N.J. $7,562,972. Manufacture of AN/TPQ-27 radar equipment. Naval Electronic Systems Command, Washington, D.C. N00039-69-C-3539.

—**Infrared Industries, Inc.**, Waltham, Mass. $1,322,986. Optics assemblies for proximity fuses for 5-inch 38 and 5-inch 54 caliber ammunition. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104-69-C-0372.

—**Barnett Construction Co.**, Memphis, Tenn. $1,308,000. Construction of the first increment of an enlisted men and non-commissioned officer's club, Naval Air Station, Memphis, Tenn. Naval Facilities Engineering Command, Washington, D.C. N62467-67-C-0166.

—**General Dynamics Corp.**, Groton, Conn. $5,823,500 (contract modification). Additional design agent services in support of the Fleet Ballistic overhaul program (USS Lafayette SSBN 616 class). Naval Ship Systems Command, Washington, D.C. NObs 38/A.

—**North American Rockwell Corp.**, Anaheim, Calif. $3,441,000. Repair of Ships Inertial Navigation Systems gyroscope and velocity meters. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5012 POO1.

—**General Dynamics Corp.**, Groton, Conn. $2,107,100. Engineering and planning yard services to support the alteration, maintenance, repair and overhaul of operational submarines. Naval Ship Systems Command, Washington, D.C. N00024-69-C-0239 PZ02.

—**Sperry Rand Corp.**, Syosset, N.Y. $2,082,000. Technical assistance program for Poseidon C-3 missile logistic support. Naval Ship Systems Command, Washington, D.C. N0024-70-C-5041.

15—**Forsberg and Gregory, Inc.**, Redlands, Calif. $1,528,380. Construction of an aircraft maintenance hanger, Marine Corps Air Facility, Santa Ana, Calif. Naval Facilities Engineering Command, Washington, D.C. N62473-68-C-0156.

—**Jefferson Construction Co.**, Cambridge, Mass. $1,065,150. Construction of Waves Bachelor Officer Quarters, Naval Station, Newport, R. I. Naval Facilities Engineering Command, Washington, D.C. N62464-68-C-0108.

—**Sperry Rand Corp.**, Syosset, N.Y. $10,450,000. One year engineering service program for the Polaris/Poseidon system. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5008.

—**General Dynamics Corp.**, Groton, Conn. $3,962,960. Design services in support of the Fleet Ballistic Missile submarine second overhaul program (USS George Washington SSBN 598 class). Naval Ship Systems Command, Washington, D.C. N00024-69-C-0235 PZ04.

16—**Arnold M. Diamond, Inc.**, Great Neck, N.Y. $1,123,958. Land fill and site improvements, U.S. Naval Academy, Annapolis, Md. Naval Facilities Engineering Command, Washington, D.C. N62477-68-C-0829.

—**VARO, Inc.**, Garland, Tex. $6,944,000. Mk 344 Mod O and Mk 376 Mod O electric bomb fuzes. Naval Air Systems Command, Washington, D.C. N00019-70-C-0057.

—**North American Rockwell Corp.**, Columbus, Ohio. $2,361,697 (contract modification). Evaluate the feasibility of an improved target marking and light armament system for the OV-10A aircraft. Naval Air Systems Command, Washington, Washington, D.C. N00019-69-C-0445.

—**Hazeltine Corp.**, Little Neck, N.Y. $1,040,000 (contract modification). Electronic packages for AN/GSQ-141/142 receiving transmitting sets, less batteries, for the Army. Naval Air Systems Command, Washington, D.C. N00019-69-C-0617.

17—**Lockheed Missile and Space Co.**, Sunnyvale, Calif. $28,136,478. Tactical engineering services for the Fleet Ballistic Missile Weapon System (Poseidon and Polaris). N00030-70-C-0020. $9,685,948. Polaris tactical field engineering services. N00030-70-C-0008. Naval Strategic Systems Project Office, Washington, D.C.

—**North American Rockwell Corp.**, Anaheim, Calif. $4,084,000. Repair of Mk II Ships Inertial Navigation Systems components. N00024-70-C-5016 PO01. $1,239,000. Engineering services for Ships Inertial Navigation Systems during Poseidon conversion of Fleet Ballistic Missile submarines. Newport News, Va., Groton, Conn., Vallejo, Calif., Portsmouth, N.H., and Bremerton, Wash. N00024-70-C-5018. $1,128,924. Mardan Computers for Ship Inertial Navigation Systems compoponents. N00024-70-C-5047. Naval Ship Systems Command, Washington, D.C.

—**Sperry Rand Corp.**, Long Island, N.Y. $1,913,929. Repair services of Fleet Ballistic Missile submarine navigation subsystem components. Syosset, N.Y. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5034.

18—**Computer Sciences Corp.**, El Segundo, Calif. $1,068,758. System analysis design, flow charting and programming support for Navy Data Systems and Operating Systems. Navy Electronic Laboratory Center, San Diego, Calif. Navy Purchasing Office, Los Angeles, Calif. N00123-70-C-0146.

22—**Seal and Co., Inc.**, Washington, D.C. $4,948,000. Construction of a VLF antenna system, Naval Radio Station, Annapolis, Md. Naval Facilities Engineering Command, Washington, D.C. N26477-68-C-1098.

—**Republic Electronic Industries, Inc.**, Melville, N.Y. $2,241,351. AN/ARN-52(V) TACAN navigational sets. Naval Aviation Supply Office, Philadelphia, Pa. N00383-70-C-0408.

—**Martin-Marietta Corp.**, Baltimore, Md. $1,578,925 (contract modification). Work on the Hart/Zap weapon system. Naval Ordnance Laboratory, White Oak, Md. N60921-68-C-0277 PO12.

—**LTV Aerospace Corp.**, Dallas, Tex. $1,250,000 (contract modification). Incremental funding for the flight demonstration program of a JP-5 fueled, air-launched ramjet propulsion system. Naval Air Systems Command, Washington, D.C. N00019-68-C-0605.

23—**Arnold M. Diamond, Inc.**, Great Neck, N.Y. $2,212,248. Construction of a steam plant and electrical distribution systems, Public Works Center, Pensacola, Fla. Naval Facilities Engineering Command, Washington, D.C. N62467-67-C-0544.

—**Collins Radio Co.**, Dallas, Tex. $1,461,986. Engineering, furnishing, installing and testing a microwave wide-band, line-of-sight communications system. Naval Electronic Systems Command, Washington, D.C. N00039-70-C-0502.

—**Grumman Aerospace Corp.**, Bethpage, N.Y. $1,200,000 (contract modification). Incremental funding for EA-6B aircraft. Naval Air Systems Command, Washington, D.C. N00019-67-C-0078.

24—**Sanders Associates, Inc.**, Nashua, N. H. $3,213,959 (contract modification). Airborne receiver transmitters and associated equipment. Naval Air Systems Command, Washington, D.C. N00019-68-C-0630.

—**Lear Seigler, Inc.**, Oklahoma City, Okla. $2,208,663. Services and materials for progressive aircraft rework on S-2 series aircraft. Brookley Industrial Air Park, Mobile, Ala. Naval Air Systems Command, Washington, D.C. N00019-70-C-0048.

—**Simplex Wire and Cable Co.**, Portsmouth, N.H. $1,332,069. Manufacture of 21-Quad Multipair submarine cable. Naval Electronic Systems Command, Washington, D.C. N00039-70-C-3504.

25—**Newport News Shipbuilding and Dry Dock Co.**, Newport News, Va. $88,000,000. Construction of two nuclear-powered attack submarines (SSN 686 and 687) of the USS Sturgeon (SSN 637) class. Naval Ship Systems Command, Washington, D.C. N00024-69-C-0307.

—**Clevite Corp.**, Cleveland, Ohio. $3,000,000. Increased limitation of authorization for Mk 48 Mod 1 torpedoes. Naval Ordnance Systems Command, Washington, D.C. N00017-69-C-1426.

—**General Motors Corp.**, Indianapolis, Ind. $2,661,000. Rotor assemblies for TF41 engines for A-7E aircraft. Naval Aviation Supply Office, Philadelphia, Pa. F34601-69-2021-GB01.

28—**United Aircraft Corp.**, East Hartford, Conn. $5,800,000 (contract modification). Increase in limitation of authorization for design, development and testing of the TF30-P-412 aircraft engine. Naval Air Systems Command, Washington, D.C. N00019-69-C-0393.

29—**Sperry Rand Corp.**, St. Paul, Minn. $9,749,500. Computer systems with associated services and support. Naval Ship Systems Command, Washington, D.C. N00024-69-C-1402.

—**Stanwick Corp.**, Arlington, Va. $1,528,-

842. Computer programming services for type commanders, at various locations. Navy Purchasing Office, Washington, D.C. N00600-70-D-0151.

—**Planning Research Corp.**, Los Angeles, Calif. $1,407,855. Programming services in support of type commanders, at various naval activities. Navy Purchasing Office, Washington, D.C. N00600-70-D-0151.

—**United Aircraft Corp.**, East Hartford, Conn. $1,058,589. Spare parts for J-48 P8/8A engines used on F9 aircraft. Naval Aviation Supply Office, Philadelphia, Pa. N00383-0-69000A-AG405.

—**Beatrice Food Co.**, Honolulu, Hawaii. $1,081,648. Supplies of dairy products for fleet and shore stations. Naval Supply Center, Pearl Harbor, Hawaii. N00604-70-D-0016.

—**Magnavox Co.**, Fort Wayne, Ind. $1,000,000 (contract modification). Research and development on an airborne processor and display system. Naval Air Systems Command, Washington, D.C. N00019-69-C-0606.

—**Honeywell, Inc.**, Minneapolis, Minn. $1,092,933 (contract modification). AN/APN-171(V) altimeter sets and associated equipment for the Navy and Air Force. Naval Air Systems Command, Washington, D.C. N00019-69-C-0388.

30—**Lockheed Aircraft Corp.**, Marietta, Ga. $3,555,577 (contract modification). Research and development on a classified project. Naval Air Systems Command, Washington, D.C. N00019-69-C-0309.

—**Canadian Commercial Corp.**, Ottawa, Canada. $2,799,290. AN/ASH-20(V) flight recorder-locator systems and special support equipment. Carleton Place, Ontario, Canada. Naval Air Systems Command, Washington, D.C. N00019-70-C-0047.

—**North American Rockwell Corp.**, Anaheim, Calif. $1,534,380. Design, development, fabrication, testing and evaluation of prototype gyroscopes. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5040.

—**Communications and Systems Corp.**, Falls Church, Va. $1,249,846. Data processing and analysis relating to Fleet Maintenance, support, overhaul, and readiness of a standard navy maintenance and material management system. Naval Ship Systems Command, Washington, D.C. N00024-69-C-5220.

31—**GAP Instrument Corp.**, Westbury, N.Y. $2,981,670. Mk 53 Mod O attack consoles. Naval Ordnance Systems Command, Washington, D.C. N00017-70-C-0401.

—**General Precision Inc.**, Binghamton, N.Y. $1,500,000. Two units of RF-4E weapons training sets. Naval Training Device Center, Orlando, Fla. N61339-70-C-0009.

DEPARTMENT OF THE AIR FORCE

1—**Pan American World Airways, Inc.**, New York, N.Y. $97,450,000. Services necessary to the operation of the Eastern Test Range, Brevard County, Fla. Air Force Eastern Test Range, AFSC, Patrick AFB, Fla. F08606-68-C-0040.

—**Aro, Inc.**, Arnold Air Force Station, Tenn. $48,960,000. Management, operation and maintenance of the Arnold Engineering Development Center, Arnold Air Force Station, Tenn. Arnold Engineering Development Center, AFSC, Arnold AFS, Tenn. F40600-69-C-0001.

—**North Electric Co.**, Galion, Ohio. $9,821,926. Procurement of 24 switching centers for the 407L tactical communication system. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628-67-C-0270.

—**Boeing Co.**, Seattle, Wash. $6,095,843. Design, development, study and testing programs for WS-133A-M and WS-133B Minuteman missiles. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0153.

—**Northrop Corp.**, Hawthorne, Calif. $1,366,160. Production of long lead time for F-5 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1289.

2—**McDonnell Douglas Corp.**, Tulsa, Okla. $1,603,236. Rehabilitation of Air Force Plant #3. Aeronautical Systems Division, AFSC, Wright Patterson AFB, Ohio. AF33 (657)16416.

—**General Electric Co.**, Syracuse, N.Y. $9,263,760. Operation, maintenance and logistic support of spacecraft sensor sights for FY 1970. Shemya AFS, Alaska, Diyarbakir, Turkey, and Syracuse. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04604-69-C-0941.

—**RCA**, Moorestown, N.J. $4,839,946. Depot level maintenance and supply support for instrumentation radar systems. Air Force Eastern Test Range, AFSC, Patrick AFB, Fla. F08606-69-C-0051.

—**William V. Austin & Assoc.**, Ventura, Calif. $1,701,001. Base support services at Los Angeles AFS, El Segundo, Calif. 6592nd Support Group, Los Angeles AFS, Calif. F04693-69-C-0057.

—**General Dynamics Corp.**, Fort Worth, Tex. $1,515,000. Operation, maintenance and improvemnt of the radar target scatter facility, Holloman AFB, N.M. Air Force Missile Development Center, AFSC, Holloman AFB, N.M. F29600-69-C-0016.

3—**Vitro Corp. of America**, Eglin AFB, Fla. $11,738,326. Maintenance and operation of armament development test center range facilities, Eglin AFB, Fla. Armament Development and Test Center, AFSC, Eglin AFB, Fla. F08635-70-C-0070.

—**Hayes International Corp.**, Birmingham, Ala. $8,511,040. Inspect and repair as necessary KC-135 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-68-C-3607.

—**Collins Radio Corp.**, Cedar Rapids, Iowa. $6,150,704. Spare parts for integrated dual flight director/rotation go-around systems. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-2462.

—**Emerson Electric Co.**, St. Louis, Mo. $1,840,824. General purpose automatic test system in support of various types of aircraft. San Antonio Air Materiel Area, AFLC, Kelley AFB, Tex. F41608-68-C-8961.

—**General Supply Corp.**, Limestone, Maine. $1,485,020. Repair siding and foundations on housing units, Loring AFB, Maine. 42nd Bombardment Wing, Loring AFB, Maine. F17600-69-C-0136.

—**Hazeltine Corp.**, Little Neck, N.Y. $5,927,699. Production of command and control electronics equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-68-C-0539.

—**LTV Electrosystems, Inc.**, Greenville, Tex. $1,645,000. Modification of C-130 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-68-C-0707.

—**General Dynamics Corp.**, Fort Worth, Tex. $1,410,216. Aerospace ground equipment for F-111D aircraft. Aeronoutical Systems Division, AFSC, Wright-Patterson AFB, Ohio. AF33(657)13403.

—**Sperry Rand Corp.**, Great Neck, N.Y. $1,410,280. Refurbishment and modification of transportable radio navigational sets, air conditioners, related shelters, engineering services and spare parts. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1362.

—**Westinghouse Electric Corp.**, Pittsburgh, Pa. $2,317,775. Procurement of anti-intrusion alarm sets, spare parts, and aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0447.

7—**Systems Development Corp.**, Santa Monica, Calif. $9,929,770. Computer program updating and development of a system training program. F04606-69-C-0522. $2,345,568. Computer program updating and development of system training programs for major Air Force commands. F04606-69-C-1239. $1,666,000. Services in support of the Space Defense Center's computer program. F04606-69-C-1238. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif.

—**General Dynamics Corp.**, Fort Worth, Tex. $3,228,034. Modification, inspection and repair as necessary of B-58 aircraft. James Connally Airport, Waco, Tex. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-70-C-0002.

8—**Bendix Corp.**, Teterboro, N.J. $7,591,000. Modification of B-52 aircraft. Oklahoma Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-2685.

—**Modulux, Inc.**, Newark, Calif. $4,226,119. Production of 63 modular relocatable units for use as school facilities. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-69-C-4486.

10—**Lear Siegler, Inc.**, Oklahoma City, Okla. $2,648,000. Time and materials contract for aircraft maintenance services on F-4 aircraft at Yokota AB, Japan. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-4413-0001.

—**Dynalectron Corp.**, Fort Worth, Tex. $1,273,000. Time and materials contract for aircraft maintenance on F-4 aircraft at Alconbury RAF, England. Oklahoma Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-4415-0002.

11—**Lockheed Aircraft Corp.**, Marietta, Ga. $1,924,287. Spare parts for the C-5 aircraft. San Antonio Air Materiel Area, AFLC, Detachment 31, Marietta, Ga. AF 33(657)15053.

14—**Kollsman Instrument Corp.** Elmhurst, N.Y. $1,994,960. Production of pressure-temperature test sets. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-69-D-9020.

16—**Maney Aircraft Parts, Inc.**, Gardena, Calif. $1,721,860. Modification of F-100 aircraft. Brea, Los Alamitos, Gardena, and Santa Ana, Calif. Sacramento Air Materiel Area, AFLC, McClellan AFB, Calif. F04606-70-C-0058.

17—**Northrop Corp.**, Hawthorne, Calif. $2,715,775. Modification kits for T-38A aircraft. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F04606-69-A-0218-QP01AA.

—**Atkins and Merrill, Inc.**, Marlboro, Mass. $1,028,050. Modification kits applicable to RF-4 series aircraft. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600-69-A-4361-0001.

18—**General Motors Corp.**, Indianapolis, Ind. $12,236,260. Procurement of TF-41-A-2 turbofan aircraft engines. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-67-C-0163-P073.

—**North American Rockwell**, Anaheim, Calif. $5,000,000. Research and development of the post boost propulsion system for Minuteman III. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-68-C-0040.

—**Chicago Aerial Industries, Inc.**, Barrington, Ill. $1,960,389. Procurement and installation of aerial cameras in RF-4 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1282.

22—**Rand Corp.**, Santa Monica, Calif. $10,400,000. Increment to contract for aerospace studies and research. Air Force Office of Scientific Research, Washington, D.C. F44620-67-C-0045.

—**Borg-Warner Corp.**, Van Nuys, Calif. $3,186,321. Procurement of parts for B-52 aircraft. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601-69-C-4073.

24—**Lockheed Aircraft Corp.**, Marietta, Ga. $10,000,018. Production and modification of C-141 aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. AF33 (657) 14885.

—**Honeywell, Inc.**, Lexington, Mass. $1,600,000. Reconaissance equipment, spare parts and aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-1099.

25—**Fairchild Hiller Corp.**, Germantown, Md. $3,000,000. Repair and modification of C-119 aircraft. St. Augistine, Fla. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603-68-C-1633.

—**The Ohio State University Research Foundation**, Columbus, Ohio. $1,102,189. Academic services in support of the Air Force Institute of Technology schools of systems and logistics, and civil engineering. Air Force Institute of Technology, Wright-Patterson AFB, Ohio. F33608-70-C-0001.

—**Continental Aviation and Engineering Corp.**, Neosho, Mo. $1,224,336. Repair of J-69 engines. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-69-D-2080.

—**Honeywell, Inc.**, St. Petersburg, Fla. $40,180,841. Guidance and control systems for the Minuteman III missile system. Space and Missile Systems Organization, AFSC, Los Angeles, Calif.

28—**Lockheed Aircraft Corp.**, Marietta, Ga. $7,845,835. Spare parts for C-5A aircraft. Detachment 31, Headquarters, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF33 (657)15053.

—**Cessna Aircraft Co.**, Wichita, Kans. $7,668,395. Production of A-37B aircraft, spare parts, and aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0834-PZ03.

—**LTV Electrosystems, Inc.**, Dallas, Tex. $1,391,355. Airborne data processing equipment, spare parts and related test equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657-69-C-0844.

29—**TRW Systems Group**, Redondo Beach, Calif. $12,799,999. Non-development support for Minuteman weapon system. F04701-69-C-0180. $6,500,000. Development support for Minuteman weapon system F04701-69-C-0179. Norton AFB, Calif. Space and Missile Systems Organization, AFSC, Los Angeles, Calif.

—**Curtis-Wright Corp.**, Woodridge, N.J. $2,349,373. Overhaul of J-57 series engines and components. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F41608-69-D-0006.

30—**Control Data Corp.**, Minneapolis, Minn. $1,948,000. Procurement of engine test cell automatic process control equipment and data. La Jolla, Calif. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608-70-C-5247.

—**LTV Aerospace Corp.**, Dallas, Tex. $1,192,138. Advanced missile post boost system study. Grand Prairie, Tex. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0370.

31—**Federal Electric Corp.**, Paramus, N.J. $27,795,801. Operation and maintenance of the Air Force Western Test Range technical facilities. Vandenberg AFB, Calif. Air Force Western Test Range, AFSC, Vandenberg AFB, Calif. F04697-67-C-0001.

—**General Electric Co.**, Philadelphia, Pa. $14,412,628. Research and development of the Mk 12 Re-entry System. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. AF 04(694)-916.

—**Singer-General Precision, Inc.**, Little Falls, N.J. $2,300,000. Inertial instrument development of the Advance Ballistic Reentry System. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701-69-C-0177.

ASPER Case Listing

(Continued from Page 32)

ernment property. Revisions to DD Form 1662 are included in the case and the subcommittee report is expected soon.

Financial Accounting for Government-Owned Facilities. To consider the contents of ASPR Appendices B–301 and C–301 relative to the requirement for the maintenance of financial records by contractors. The General Accounting Office has recommended that contractors be required to maintain such records. The case is presently being studied by a subcommittee.

Single Service Management of Industrial Facilities. To develop procedures which will provide that only one contract authorizing use of government facilities will be in effect at any one location. It is intended that contracts which authorize the acquisition or furnishing of government facilities will provide for the automatic transfer of those facilities to the "use" contract upon receipt of installation. The subcommittee report is under review.

Corporate Administrative Contracting Officer Program. To provide for the appointment of a single corporate administrative contracting officer (ACO) to act, in the case of multi-plant companies, on matters which have corporate-wide application. The corporate ACO will not act on matters having only local application. These matters will continue to be received by the plant ACO. Development of this case will be completed in the near future.

From The Speakers Rostrum

(Continued from Page 17)

ment. However, to do our job right, we need to know more about the quality of transportation.

As engineers, you would not think of building a bridge without standards describing the quality of materials to be used. Nor would you use these materials without testing them to ensure they meet prescribed standards. We do not now have such standards to describe the quality of transportation, nor tests to reproduce the environment. Accordingly, it is hoped that by joint action of the technical societies, the universities, and as individuals in your everyday work, you will continue and renew your interest and efforts to define transportation engineering and to establish transportation performance standards.

You are the engineers who have the talent to improve the quality of the nation's transportation service. We, in the Defense Department, are anxious to cooperate with you and stand ready to assist you in your efforts. We know, as few others can, how essential transportation is to the success of the mission of national defense.

Sir Winston Churchill knew and he defined it well when he said:

> ***Victory is a beautiful rose, but transportation is the stem without which the flower cannot grow.***

DSA Quality Assurance

(Continued from Page 10)

be given to human error. Safety precautions will be programmed so that an erroneous command by the operator will be invalidated or curtailed, and a warning buzzer or light will alert the operator to correct or issue a new command or instruction to the computer.

A project has been assigned to the Staff Instrumentation Engineer in the Quality Assurance Directorate to develop and/or determine the required standards, frequency, and calibration and measurement devices for automated processes. The scope of the project will encompass industry, other elements of DOD, National Bureau of Standards, and other agencies to assure establishment of realistic standards, techniques and frequencies of calibration. This action will result in modification of present calibration specification and various test methods and procedures.

Recognizing the emergence of automated production technology and the increased specialized skill requirements, the DCAS Quality Assurance Directorate has programmed internal and external training and education courses to ensure that quality assurance personnel understand and become part of the automated age. Present emphasis is on computer technology and advanced statistical concepts for progression in the employee's development program. In addition, personnel recruitment is slanted more and more toward professional personnel. The DCAS Quality Assurance Directorate is preparing to meet the challenge of automation and will be ready when tomorrow becomes today. As one of our leading industry's advertisment states, "Man thinks; machines work."

Blade De-Icers Aim of Army Chopper Program

Icing on vertical take-off and landing (VTOL) aircraft is getting a hard look from the Army. Combat Developments Command (CDC), Fort Belvoir, Va., has visions of lightweight, removable anti-icing/de-icing equipment for VTOLs, utilizing surface coatings, electrothermal, hot-air thermal, or fluid and mechanical devices.

Major problems caused by icing include severe vibration from uneven shedding of ice by the rotor blades, decreased visibility, and loss of lift and performance from airfoil distortion. Icing also lowers engine performance, and can cause damage when ingested by the engine.

Modern, high-powered helicopters suffer less performance losses under icing conditions than older, lower-powered models did, but still suffer from vibration damage. Until icing can be neutralized or prevented, the operational flexibility offered by modern engines, instrumentation, electronics and increased stability will never be fully realized.

Army Exploring New Laser Uses

Under the guidance of the Combat Developments Command (CDC), Fort Belvoir, Va., the Army is moving into the age of the laser. Presently under study at CDC are laser programs ranging from combat to support activities, for use now through the 1980s.

The laser generates an intense light through exitation of the atomic structure of its source substance. Different substances produce light of different wavelengths, with different capabilities and potentials.

A ruby laser has already been used as a range finder in tests with the M160A1E2 tank. In these tests, the ruby laser provided quick and accurate weapon to target distance figures, promising increased "first round kills" for future armor missions. CDC also sees possibilities in artillery, air defense and other firepower areas, where effectiveness depends on accuracy and speed.

Point-to-point communications also has applications, according to CDC. Improvements in lasers and fiber optics could permit a single channel to simultaneously carry 100 million telephone calls, coast to coast. Very highly "coherent" lasers could bring advances in communications security control, making it almost impossible for any enemy to jam or tap such a system. In a related area, some day lasers may be used to recharge tactical and strategic satellites in orbit.

With lasers, surveyors could determine topographic features accurate to the nearest centimeter, or even millimeter, instead of the nearest meter. Surveillance and target acquisition may see television-like images and displays, thanks to laser; and weed control may use the laser for clearing highways and waterways.

The laser has already been used for delicate eye surgery, and in the future it may be used for treatment of certain cancer types. The high heat levels of certain lasers may find application in sterilization, reducing the amount of equipment now required by medics in the field, and bringing instantaneous food treatment and preparation to realization.

Lasers operating in the invisible regions of the spectrum may provide new concepts in night operations and weaponry, while the cyanide laser, which operates in areas of the spectrum that pass easily through the atmosphere, may contribute to further exploitation of "paths of least resistance."

The uses of the laser seem limited only by human imagination ,according to CDC's Electronics Division. By the 1980s the laser may be as common as the helicopter is today.

New Earth Movers Goal of Army Engineers

The Army is out to get rid of dirt. In a recent Qualitative Materiel Development Objective, issued by the Army Combat Developments Command (CDC), Fort Belvoir, Va., CDC's Engineer Agency asked for the development of highspeed excavating equipment, materiel and techniques.

With an increased emphasis on mobility and dispersion, CDC foresees the development of radically new equipment. Present needs for rapid construction of roads, barriers, obstacles, artillery emplacements, and personnel, command and supply shelters are expected to increase. The Army also see such machines as an effective means of decontaminating areas of chemical-biological-radiological contamination.

CDC is seeking materiels and techniques that would increase productivity and reliability. The machinery would weigh less and be easier to maintain. It would be able to travel cross-country or in convoy, or be deliverable by aircraft or heavy-lift helicopters. The new equipment should also result in reductions of the number of items, and the weight of existing equipment, in the Army inventory, and in logistics, training requirements and operating personnel.

One of the new concepts in excavating machines is REDSOD—the Repetitive Explosive Device for Soil Disaggregation and Displacement. Attached to conventional equipment, such as the crawler tractor, REDSOD has a theoretical potential of up to 150,000 cubic yards per hour, compared to the 125-cubic-yards-per-hour limit of present machinery.

Relatively lightweight—at 25 tons—REDSOD uses controlled explosions to move earth. REDSOD consists of a dozer blade with multiple chambers. A mixture of compressed air and fuel is fed into the chambers and, when sufficient pressure has built up, a spark ignites the mixture. The expanding gases are directed out of slots at the base of the blade into the ground, blasting out the earth. Continuous ignition in the chambers results in continuous eruption of the earth. For use in both soil and soft rock, REDSOD would ideally, control the direction of excavated earth, placing it in rows 5 to 20 feet from the work site.

Free-Drop Food Containers Sought by Army

Free-drop containers may be used in the near future to deliver drinking water to troops in remote areas and, under guidelines specified by the Army Combat Developments Command (CDC), Fort Belvoir, Va., the weather-resistant, disposable containers could also be used for beverages or dry food.

Use of the containers would simplify present problems of supplying special action forces operating in areas with minimum support, where potable water and food supplies are difficult to obtain.

The free-drop containers would withstand impacts from helicopters or fixed-wing aircraft operating at altitudes between 50 and 250 feet, at speeds up to 130 knots. CDC also calls for the containers to have 3-gallon capacity, to be resealable after partial use, and to be reusable.

Changing Address?

The *Defense Industry Bulletin* mailing list is prepared by computer. When requesting a change in address or stopping a subscription, readers must send the mailing label from the back cover of the magazine. Without this label, changes cannot be made. Do not alter or deface the label. Allow two months for change of address. Changes and labels should be sent to the Editor, Defense Industry Bulletin, OASD (Public Affairs), The Pentagon Washington, D.C. 20301.

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AFLC Reorganization Plans Announced

The Air Force Logistics Command (AFLC) has announced a reorganization and consolidation of functions at its headquarters at Wright-Patterson AFB, Ohio, expected to become operational by October 15.

Following an extended planning study, General Jack G. Merrell, Commander, AFLC, announced the changes in a letter to AFLC staff components.

The letter called for the establishment of a Deputy Chief of Staff for Materiel Management, intended to centralize weapon systems and commodity management control functions presently associated with the the Deputy Chiefs of Staff for Operations, Supply, and Maintenance.

Brigadier General W. W. Snavely, major general nominee and present Deputy Chief of Staff for Plans, will head the new office. His assistant will be Brigadier General W. A. Jack, the current Assistant Deputy Chief of Staff for Supply.

Remaining functions of the Deputy Chief of Staff for Operations will be consolidated with the Deputy Chief of Staff for Plans designated as the Deputy Chief of Staff for Plans and Operations. The present Deputy Chief of Staff for Operations, Major General F. J. Ascani, will become Deputy Chief of Staff for Plans and Operations. His principal civilian assistant, W. W. Klare, will remain with General Ascani.

The functions of the Deputy Chief of Staff for Supply, including distribution, will be consolidated with those of transportation under a new Deputy Chief of Staff for Supply and Transportation to be headed by Colonel R. E. Carlson, present Deputy Chief of Staff for Transportation. His number one civilian assistant will be J. E. Reynolds.

The Deputy Chief of Staff for Maintenance Engineering will be redesignated Deputy Chief of Staff for Maintenance, with responsibilities for staff surveillance of industrial operations and all production functions. Brigadier General R. E. Hails, now Assistant Deputy Chief of Maintenance Engineering, will assume the new position, with J. M. Myer as his top civilian aide.

Marines, Army Propose Mini-Transceiver

A 20-ounce single unit radio transceiver small enough to fit inside a soldier's fatigue vest pocket is under study by the Army and Marine Corps. A prototype of the radio has been developed by the Marine Corps, and the Army Combat Developments Command, (CDC), Fort Belvoir, Va., is monitoring results for the Army.

The proposed radio, AN/PRC–68, would provide two-way voice communication up to 500 meters without an external antenna system. With 1,000 channels available spaced 50 KHz apart, in the tactical frequency (FM) band, the radio would be compatible with standard military tactical field equipment. Channel selection would be predetermined.

The water and dust tight, air droppable unit is proposed for squad sized units, and the multichannels would allow many squads to operate in close proximity without interference or jamming.

The single-pack unit would replace the bulkier two-piece squad radio currently in use, increasing the unit commander's control over his forces.

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